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A FRENCH ELECTRIC LIGHT STATION.

A brief description is given on another page of the new central station of the Paris Compressed Air Company, a concern which is one of the largest concessionaires for electric lighting in the French capital. The general plan on which the lighting system of this company is laid out is one which has never come into use in this country, being what is known as the five-wire system, making use of an extension of the three-wire principle. Current is generated at 500 volts and distributed on two-wire feeders to substations wherein are storage batteries connected across the mains, from which run five-wire distribution systems, the pressure being equalized between the four 10-volt circuits of the distribution system in series with each other by means of batteries. In this way a great economy of copper is effected over the ordinary three-wire system, the outside wires being for the same load, drop and distance but one-quarter the size of those required with 220 volts, and no neutral is used between the substations and the main generating plant. The battery substations, of course, require some attendance, but storage batteries are now recognized as a profitable accessory in all direct-current systems with a fluctuating load curve, and undoubtedly the location of the batteries at the centres of distribution instead of at the generating station is a great advantage in that it improves the load factor on the feeders.

The system is interesting in that it occupies a position somewhere between the low-tension direct-current systems and the high-tension alternating-current systems, requiring, in common with low-tension systems, a greater amount of copper than do the latter, and in common with first-class alternating systems the substations not required with simple low-tension plants. Compared with the latest American practice of alternating current generation and transmission with rotary substations and direct-current distribution, it appears at quite a disadvantage. The latter allows the use of a transmission voltage ten times as high as is used in the French station referred to, resulting in a reduction of the copper used in transmission by 99 per cent., and also allows the use of larger, more efficient and less complicated generators. The large number of units (23) planned for in the French station is undoubtedly due to the inexperience in the construction of larger sizes of direct-current machines than that adopted, which is 1000 horse-power. Rotaries appear somewhat at a disadvantage in comparison with the motor-driven boosters used in the French system, while storage batteries may or may not be used with a rotary plant. A five-wire distribution may be used with the latter, if the corresponding economy of copper outweighs the disadvantage of higher voltage in the distribution circuits, or a three-wire system may be used if the reverse is the case.

ENGINEERING EDUCATION AND CHARACTER.

The objects of education are to provide the student with useful information, to train his mind to habits of orderly thought, and to form his character in the mould of propriety. The curricula of schools have suffered a gradual but widespread evolution during the last century, many subjects that once formed the essentials of a school course having disappeared entirely, many more having sunk into relatively unimportant esteem, while new subjects have taken their places and new ideas permeated the communities of learning. It has not been very long since the compulsory study of Greek was

a feature of our college courses. It is only within very recent years that engineering and technical education have appeared as part of the programme of institutions of learning.

It is not possible to make any general statement as to the relative values of various sorts of instruction, because so many factors enter the problem presented by each case; but it can be said that some sorts of instruction have a better effect for the formation of character and the founding of principles of morality than others, and conspicuous among these is instruction in engineering. That this claim should be urged may seem strange at first, but when it is considered that engineering means the adaptation of natural laws to beneficent purposes; that high accuracy and absolute honesty of thought are essential to the success of an engineering career; that least of all men may the engineer deceive himself or argue himself into belief in dogmatic assertion—then it will be seen at once that proper training in this profession contains just the discipline needed for the foundation of the highest character. Furthermore, the very materiel of his profession brings the engineer into contact with the unchanging laws of nature, makes him familiar with the operations of absolute principles, teaches him to reason his conclusions with perfect honesty from known grounds, and hence makes him think straight and think the truth—the first essentials to good character.

The admirable essay of Mr. H. G. Prout on this subject, from which an extract was printed in the last issue of The Electrical World, contains much worthy of serious thought. Long have the "humanities" been extolled as the proper food for growing minds, and generations of boys have plodded over the same weary course of classics and fable, of history and grammar, of myth and speculation. Are these things as good as the study of nature? Is a rule of syntax a more excellent basis for mental training than Ohm's law? Is a chemical formula less interesting than a conjugation? Are we not, after all, beginning to acknowledge the mistake that has bound generations to waste their youth in the contemplation and study of purely human inventions of law and government and language, when the whole cosmos has appealed to them to study that which is eternal and natural?

Good character is inability to do willful wrong. The nearer that one can come to emulating the precision and accuracy of natural law in his own conduct, the nearer he will approach to that perfection of character which is, or ought to be, the object of education. In no country has engineering and technical education been so widespread as in this, and nowhere is there a finer national character. The engineer must, willingly or not, be a man of precise deportment. To quote Mr. Prout: "Nature, calm and unrelenting, always stands looking at him. No other man in the world has such stern and unceasing discipline"; and so, therefore, no other man has so good a chance for the development of a firm and just character, based on the actualities of things and founded upon the immutable truths of nature.

There is perhaps no professional or industrial occupation more educating than original research into the laws of nature. This duty falls to the physicist, the chemist, the engineer and others. While the financier and the business man is to a large extent selfishly unbuilding his own interests by tearing down those of his competitors, the engineer's self-interest is best attained by work which adds to man's control over nature, aids the advancement of civilization and is therefore the truest form of altruism.

THE DEVELOPMENT OF HIGH FREQUENCY CURRENTS FOR PRACTICAL APPLICATIONS.

There will be found in another part of this paper a description of an extensive line of interrupters or circuit make and break devices lately patented by Mr. Nikola Tesla for use in the production of high-frequency currents. Oscillatory currents with a frequency of several hundred thousand alternations per second are fortunately easily generated by the simple discharge of a condenser through an inductive path, the main difficulty in producing them being the means of again starting the oscillations whenever they die out, as, of course, they do in a very small fraction of a second. The electrical method by means of a discharge is, of course, extremely wasteful, and mechanical devices for this purpose have heretofore been very troublesome, particularly in the contacts.

Mr. Tesla has been working at this problem for some years, recognizing that its solution was essential to the success of the commercial application of such currents. The results of this work appear in these recently issued patents. In general he uses a jet contact for the make and break device or circuit interrupter similar to the jets used in laboratory work for brief contacts in the determination of the wave form of alternators, etc. Mercury is preferred, owing to the high specific resistance of its vapor, and the low resistance of the liquid and a form in which jet meets jet possesses advantages, as in this case there is no sparking to or from a solid metal. Further, the contacts are made in an inclosed chamber filled with some inert gas, if necessary under considerable pressure. If atmospheric pressure is used, the apparatus is simply hermetically sealed, the small amount of oxygen contained within being soon absorbed by oxidation, leaving an inert insulating medium of nitrogen. If pressure is desired—and high pressure cuts down the arcing of such devices even more than does a high vacuo—anhydrous liquid ammonia may be used, the minute sparks gradually dissociating the ammonia into its elements, hydrogen and nitrogen, the former diffusing through the containing walls, leaving inert nitrogen under pressure.

The designer states that these machines run satisfactorily, without apparent change in the liquid, and requiring a surprisingly small amount of attention, small instruments transforming several horse-power continuously for long periods with no attention whatever. More than this, he also states that the efficiency of conversion between the direct current supplied and the high frequency current obtained, the latter being measured by calorimetric methods, is as high as 95 per cent. This being the case, the use of such currents for lighting purposes may be expected as soon as the luminous efficiency of exhausted bulbs or tubes under the action of such currents approaches or exceeds that of the incandescent filament, the fulfillment of which condition Mr. Tesla confidently promises. Such currents may also find a wide application in other fields, one of which is the electro-chemical, for the production of such compounds as ozone, in which high-frequency currents are said to give a much greater output per unit of energy than those of frequencies now used. Other chemical conversions are also readily accomplished by the same means, a promising one being the oxidation of atmospheric nitrogen, giving, if commercially practicable, promise of an enormous use of electrical energy in the production of nitrates and other nitrogenous substances, for which there is a great demand in the arts.

The Growing Importance of the Storage Battery.

In a paper read before the Engineers' Club of Philadelphia Joseph Appleton states that in the history of the electrical industry in the United States there is probably no branch which has shown such a rapid growth as in the case of the storage battery during the last three years. The following figures show the enormous increase during this time; they have been carefully compiled and represent the actual weight of storage battery plates installed. The weight is that of plates alone and does not include containing cells, acids, etc.:

1894	349,000	lbs.
1895	1,112,800	"
1896	3,315,300	"
1897	3,607,300	"

A Parisian Electric Light Station.

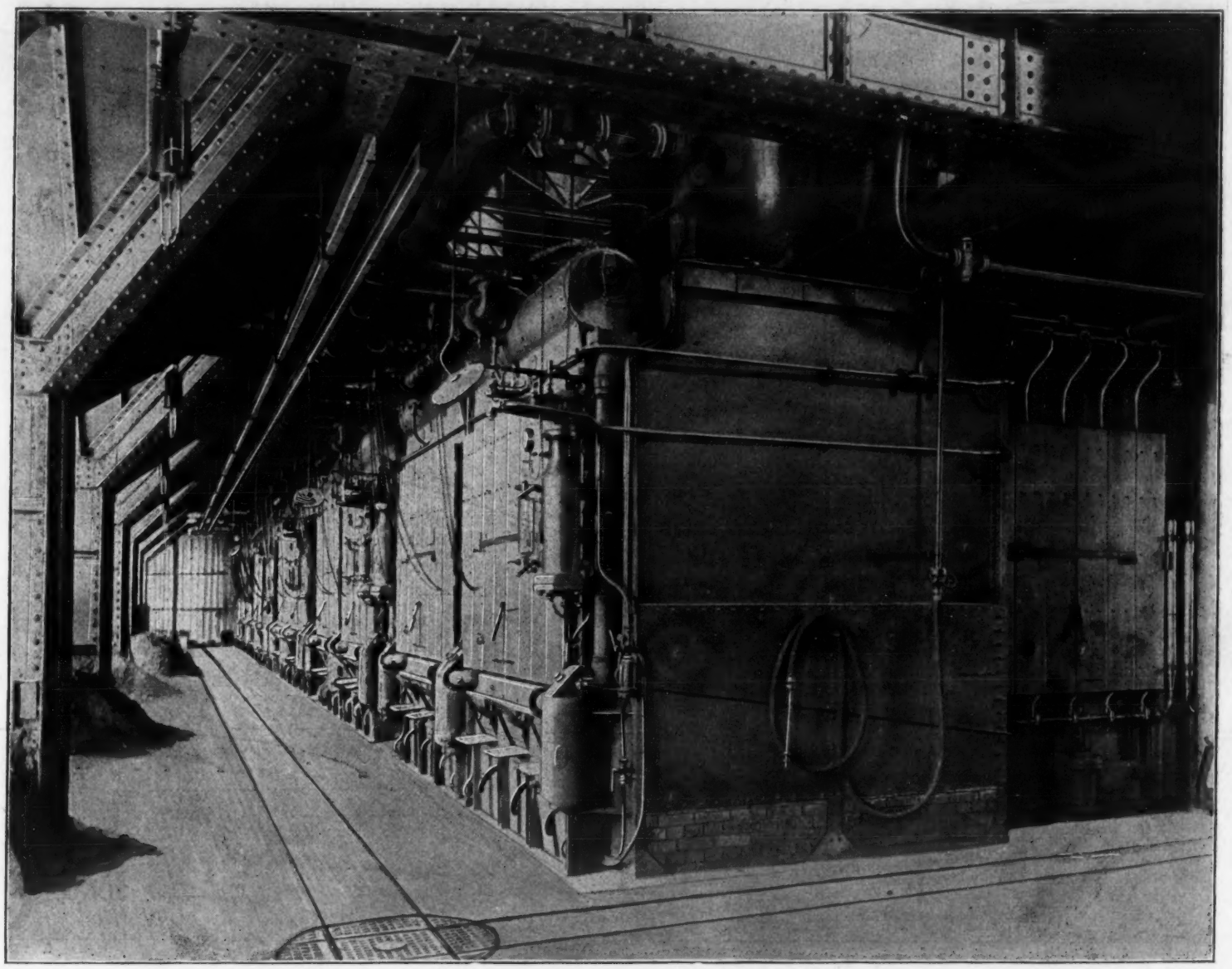
THE Paris Compressed Air Company has recently put in operation one of the most elaborate electric lighting installations in Europe. In many respects this installation is entirely different from American practice, notably in the methods of conduction and distribution and in the arrangement of the engines and generating machinery.

The new plant, situated on the Quai de Jemmapes in order to receive its coal direct from boats on the St. Martin Canal, occupies a site about 190 x 290 feet, which is entirely covered by a building of considerable height, shown in the accompanying initial. This building is divided into twenty-three practically similar parts or bays by vertical divisions, each part forming a complete generating unit and containing coal and water supply, boilers, engines, dynamos, etc. A storage battery of considerable size is also installed to aid in steadying the load and for other purposes, and provision is made for a supply of filtered water and some storage of coal.

Coal arriving in boats at the front of the building is taken by a conveyor to a point in the cellar, where it is delivered to elevators and carried to a distributing conveyor in the roof. This distributes the coal among the twenty-three bins of the various units of the generating plant. All the elevating and conveying machinery is operated by electric motors. An auxiliary supply system consisting of an elevator in which coal in carts can be taken up to the boiler level also provides an insurance against delays due to the breakage of the coal-conveying system.

Feed water is taken, through meters, from the city supply, and is purified before use by filtration. An underground reservoir containing a reserve of 330,000 gallons of the filtered water is under the floor of the pump room. Both electric and steam pumps are used for raising the water to the level of the boilers, and a reserve supply of 20,000 gallons of unfiltered water is kept in a tower surmounting the buildings. Condensation water is taken from the canal in front of the buildings through a 4-foot conduit and circulates in a sort of race-way around the building, returning to the main canal through two 35-inch pipes.

Each of the twenty-three divisions of the building contains four boilers of the water-tube variety, each producing 5500 pounds of steam per hour at a presure of 115 pounds. Three of these boilers can take care of one of the generating sets to which they are attached, and the danger of stoppage due to accidents to them is thus much diminished. Steam pumps are used for feeding, each battery of boilers having two pumps, either of which is sufficiently large to supply the four. A common stack for each battery of four boilers is provided, so that there will be in all twenty-three stacks rising from the building when the entire plant is installed. At present but seven of the groups are in place, four more being in course of construction.



THE BOILER ROOM OF A PARISIAN ELECTRIC LIGHT STATION.

Coal from the storage bins above the boilers descends by gravity to the floor in front of the fire doors and is stoked by hand. A tramway on the same level is used for the carrying away of ashes, and can be used for coal in an emergency.

Each of the generating sets consists of a vertical two-cylinder compound engine direct connected to a direct-current dynamo of about 750-kw capacity. A Corliss valve gear is used on both cylin-

ders, with detachable cut off on the high-pressure cylinder only. The high-pressure cylinder is jacketed with steam at the boiler pressure, 115 pounds, and the jacket of the low-pressure cylinder forms the intermediate receiver. The engines run at the low speed of 70 r. p. m. and at this velocity give 1200 horse-power. The dynamos are of the internal field Gramme-ring type, similar to the familiar Siemens-Halske machine, the outer elements of the armature winding forming the commutator. The field magnet, of twelve poles, is bolted to the bed plate of the machine, the armature carried on a spider overhanging it. On the smooth core of the armature the winding of bar copper is laid up of parts consisting of straight bars for the outer surface and U-shaped pieces surrounding the other three surfaces of the ring. All joints are heavily swaged and soldered. Twelve brushes carried on a star-shaped casting complete the machine. At the normal speed and excitation the output can be either 1500 amperes at 500 volts or 1200 amperes at 600 volts. The exciting winding is of the simple shunt variety, 1500 watts being used in the field. At full load the efficiency is stated to be above 92 per cent.

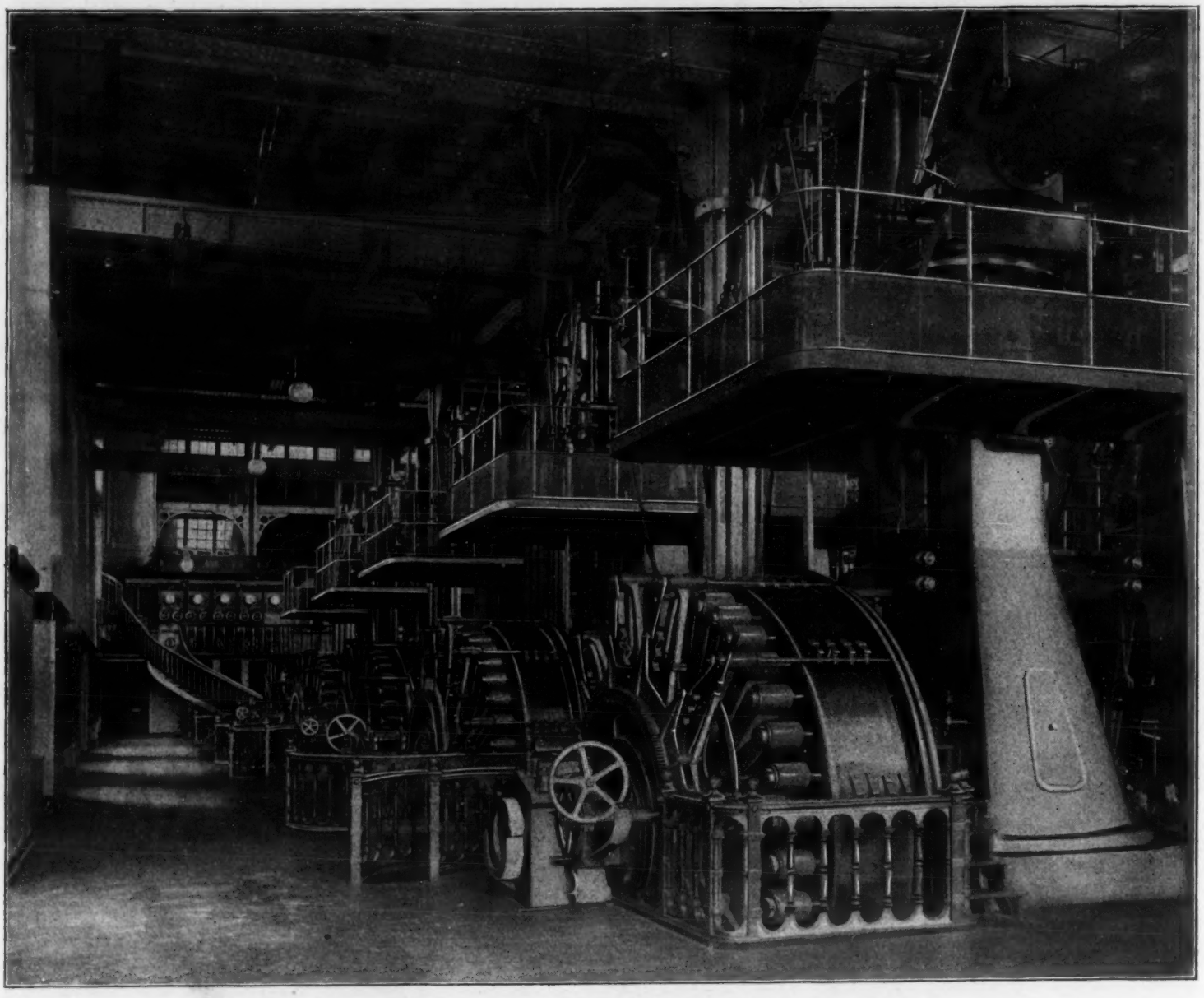
The system of distribution is by sub-stations containing accumulators, these being fed by the 500-volt current from the main plant and in turn feeding 5-wire distributing systems. The switchboard presents no great novelty of construction, except in the switches connecting the dynamos to the bus bars. These are controlled by electromagnets actuated by the current from the machine. If the speed of the machine falls so that the current reverses in it and tends to "motor" it the switches automatically open. In disconnecting a machine the process is simply to shut off the steam, the magnetic switch opening as soon as the speed is sufficiently reduced.

In a plant of such size the need for some signal system between the main switchboard and the dynamos is apparent. On each panel of the main board is mounted a number of buttons connected with an annunciator at the corresponding machine.

For the various sub-stations the pressure at the bus bars in the central plant is not the same. Pressure wires are run from each of these to the distributing board and the voltage governed in accordance with the requirements of the sub-station. Several independent cables connect each station with the central plant, and these are cut in or out as the load rises and falls in order to maintain the drop as nearly constant as possible.

On account of the fluctuations of voltage at the bus bars an independent plant is used for lighting the station. This consists of a 220-volt 50-kw dynamo driven by a motor on the main circuit, and a battery of accumulators.

Of the several sub-stations the most important is that of the Rue de Mauconseil. This contains twelve batteries of 280 elements each, each battery having an output of 2200 ampere-hours at the normal discharge of 300 amperes. Charging is accomplished by the aid of boosters, which may also be used to charge independently any quarter of the batteries that may be run down. The boosters are motor driven, of four poles, and giving from 10 to 160 volts lift in the voltage under currents up to 400 amperes. From the sub-station a five-wire circuit having 110 volts between each pair of wires is distributed. For this purpose armored cables are used, laid directly in the earth, the only precaution taken being to surround them with a layer of sand so that water drains away from them easily.



The Engine Room of a Parisian Electric Light Station.

The illustrations shown herewith are published by courtesy of "Le Génie Civil."

Mr. Tesla's Circuit Interrupters.

For the production of intermittent currents, for use in obtaining oscillatory currents of very high frequency by means of charging a circuit possessing capacity and self-induction, Mr. Nikola Tesla has designed a large number of interrupters or make and break devices embodying many ingenious features. These interrupters, or, as Mr. Tesla calls them, circuit controllers, were patented in a group of patents issued August 16, 1898.

In order to make clear the purpose of these devices it may be well to give an untechnical explanation of the means of producing high frequency or oscillatory currents. Whenever a charged condenser is short circuited through a circuit containing self-induction the sudden rush of current, by an action analogous with mechanical inertia, over-discharges the condenser, charging it up in the reverse direction; this again discharges the other way, again reversing the charge in the condenser, and so on, the oscillations gradually dying out at a rate dependent on the resistance of the circuit. With ordinary Leyden jars and the small self-induction obtained by a few turns in air, these oscillations have a frequency of several hundred thousand alternations per second, this frequency running up as the capacity of the condenser or the amount of the self-induction is diminished, being, in fact, inversely proportional to the square root of the product of the capacity and the self-induction. To start such an action the condenser must first be charged and then closed on its discharge circuit. The simplest way of accomplishing this, and the means most commonly used, is to insert a spark gap in the circuit and in shunt with this spark gap connect the secondary of a high-voltage transformer supplied with ordinary alternating current, or the secondary of an induction coil. The action, then, is as follows: As the voltage rises in the transformer the condenser is gradually charged until the pressure gets so high that it jumps across the spark gap. The spark or arc here formed is of such a low resistance that the condenser and its discharge circuit are practically short circuited through it, and the oscillations continue for a short while, until the arc dies out, the action being repeated at the next reversal of the alternating current supplied.

Such a method is extremely wasteful of power, for two reasons. First, because the secondary of the transformer is short circuited just at the peak of the wave; and, second, because the arc or spark offers some resistance to the high-frequency oscillations, which, therefore, die out more quickly than they would if they were not opposed in this way. A far better plan, therefore, is the use of a mechanical interrupter, such as those described below, the action of which can best be understood by a reference to Fig. 3. Here *A A* are the terminals of the source of supply, which may be either direct or alternating current at commercial pressures, 100, 200, 500 or 1000 volts. *A'* is a highly inductive coil which should be wound on iron. *A''* is the condenser, *B* a small self-induction, and *C* the interrupter. The action is as follows: When the circuit is open at *C*, the pressure applied from the source of supply acts through *A'* and *B* to charge the condenser, *A''*. Suddenly *A''* and *B* are short circuited through the interrupter, *C*, and the condenser discharges with oscillations, occurring perhaps several hundred thousand times per second. These gradually die out, becoming negligible after perhaps 200 or 300 oscillations, when the circuit is suddenly opened again at *C*. It should be noted that *C*, besides short circuiting the condenser through its slight self-induction, *B*, has also short circuited the source of supply connected to the terminals, *A A*, through the inductive coil, *A'*. This short circuit is so brief, however, that the incoming current has not had time to rise to an undesirable strength, but has been held back by the self-induction of *A'*. It has also while rising been storing up, so to speak, a certain amount of energy in the magnetic circuit of *A'*. Now, when the circuit at *C* is again opened, this current, passing through *A'*, tends to persist, owing to the self-induction therein, and charges the condenser *A''* up to a voltage considerably higher than that of the source of supply, the energy absorbed in the magnetic circuit of *A'* passing out thus into the condenser *A''*, charging it to a high voltage, the interrupter, *C*, afterward short circuiting this and allowing the current to oscillate again through the discharge circuit, *B*.

Thus the interrupter, *C*, inductive coil, *A'*, and the source of supply act to open the condenser circuit for a brief instant and charge the condenser by a sort of electrical blow, immediately short circuiting it again and allowing it to discharge in oscillations. If the condenser discharge circuit is tuned to a frequency of, say, 300,000 per second, and its resistance is such that 300 oscillations take place before they die down to a negligible value, the interrupter, *C*, should make and break the circuit about 1000 times a second. There will then exist in the condenser discharge circuit, *B*, a cycle somewhat as follows: A sudden surging charge followed by an oscillatory discharge, starting with high waves, which gradually die down until interrupted by the next surging charge, etc. Owing to the enormous frequency of these oscillatory discharges, they can be transformed by ordinary double-winding, stationary alternating transformers, with a very small amount of material for their capacity, since the capacity of any transformer is proportional to the rate of change of lines of force, and is hence proportional to the frequency of the alternating currents therein. So high is this frequency that an air magnetic circuit is all that is necessary, iron, in fact, being a disadvantage, owing to the energy lost within it in eddy currents and hysteresis, with such a high frequency. In the figure, *B* represents the primary of such a high-frequency air transformer, *B'* being the secondary, with a winding of more turns to obtain higher tension, the output of which is delivered to any translating devices, as *B''*.

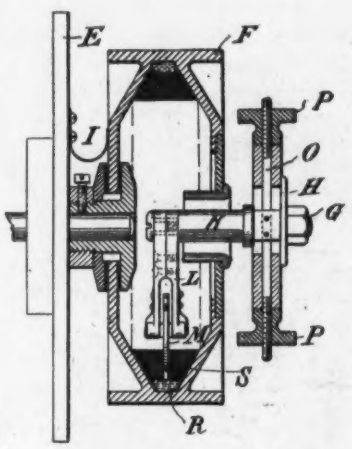


FIG. 1.

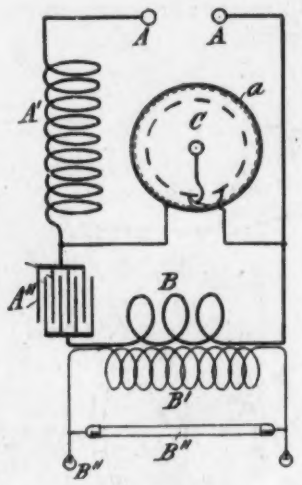


FIG. 3.

The distinguishing feature of the devices described below is the use of a liquid for one or both of the contacts of the make and break devices, this liquid preferably being mercury, acting in some instances in the form of a jet and in other cases as a surface with which a solid conductor makes and breaks a contact. Ingenious applications are also made of other principles, such as the use of a liquid dielectric between the contacts, inert gases under high pressure, jets meeting each other, etc.; and all the instruments are worked out with great perfection of detail for continuous and practically frictionless running, such as to require a minimum of attention.

The requirements of such an instrument are well stated in the patent specifications, as follows: The capability of effecting an extremely rapid interruption and completion of the circuit, the latter being positive and abrupt; the apparatus not to be liable to derangement, and capable of prolonged use without attention or adjustment.

Of the various types described the first is that shown in cross section in Fig. 1. This consists of an inclosing shell, *F*, arranged to be rapidly rotated by means of a motor coupled to the shaft shown at the left, and containing two liquids of different specific gravities, that with the higher specific gravity being a conductor and the other an insulator; preferably the conductor is mercury, the insulator being some hydrocarbon. When the shaft and shell mentioned are rapidly rotated the mercury flies to the periphery by centrifugal force and forms a ring shown at *R*, the other liquid forming an inner ring, as shown at *S*. Within the shell is an arm, *L*, supported on a non-rotating shaft, *H*, carrying a wheel, *M*, with projecting points sufficiently long to touch the mercury, *R*. As the liquids revolve they rotate this wheel at high speed, the points of which successively and repeatedly dip into the mercury rim and leave it again, the relative motion being a hypo-cycloid. The insulating liquid, under considerable pressure, owing to centrifugal action, forces itself between the mercury and the points as the lat-

ter recede and extinguishes the arcs which tend to form across these gaps. Other figures attached to the same patent show the machine assembled with a motor, condenser and transformer.

The next patent describes the waste of energy which occurs during the periods of make and break, or both, due to the passage of the current through an arc formed between the terminals; this loss of energy is said to be generally such as to render impossible a practical and economical conversion of considerable amounts of electrical energy by means of ordinary make and break devices, particularly in cases where a high frequency is required. Experiment and investigation have led Mr. Tesla to recognize the following laws governing this waste of energy: First, that the loss in any device for making and breaking a circuit, other conditions being the same, is inversely proportional rather to the square than to the first power of the relative velocity of the terminals in approaching and receding from one another in case the current curve is not so steep as to materially depart from one which may be represented by a simple sine function of the time; but such a case seldom obtains in practice; on the contrary, the current curve resulting from a make and break is generally very steep and particularly so when the circuit controller effects the charging and discharging of a condenser, and consequently the loss of energy is still more rapidly reduced by increased velocity of approach and separation.

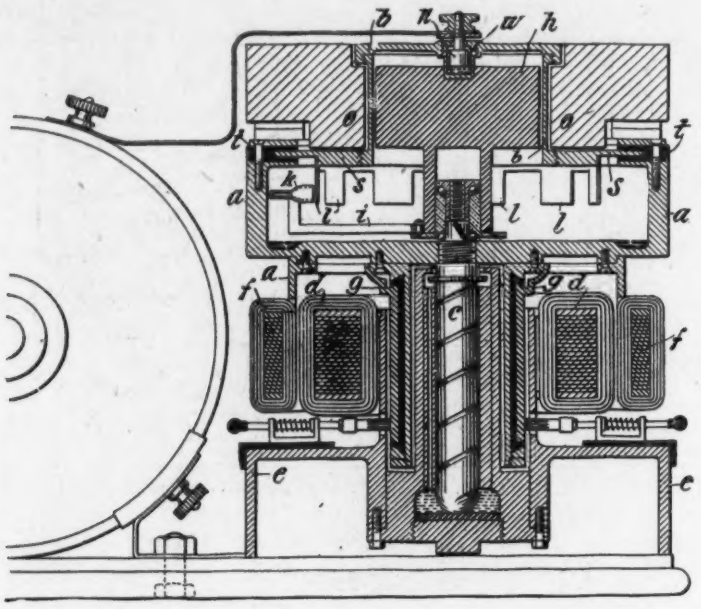


Fig. 2.

With a view to securing an interrupter in which not only the relative speed of the terminals but also the frequency of the interruption should be very high, the instrument shown in Fig. 2 was designed; this consists essentially of a shell, *a*, attached to the external armature, *f*, of a direct-current motor with a commutator, *g*, and field magnets, *d*, by which means the shell, *a*, is rotated at high speed on a self-oiling spindle, *c*. Projecting downward from the upper lid of the shell is a series of teeth, *l*, and within the case is a nozzle, *k*, arranged to throw a jet of mercury against these teeth; the nozzle is attached by means of an arm, *i*, to an armature, *h*, which is prevented from rotation by means of the field of force of an external non-rotating magnet, *o*, this field acting through the shell of the rotating case on the armature within. When mercury is placed within this case and the latter is revolved the mercury rises by centrifugal force against the outer wall and is caught by an open mouth or scoop attached to the non-rotating nozzle, *k*, and directed by the latter against the teeth, *l*. The main circuit is open between this nozzle and these teeth, and is intermittently closed by the jet of mercury.

For the further reduction of arcing others have used contacts made in a high vacuo, but Mr. Tesla claims that only a moderate improvement is secured in this manner, and this can be greatly exceeded by the use of certain fluids inert chemically maintained at a high pressure in the make and break chamber. It is found that in such a case the arc, when formed, is restricted to a small cross section or is, in other words, prevented from expanding laterally, and is therefore more quickly raised to a high resistance, choking back the current to such an extent that the arc is more promptly extinguished.

Fig. 4 shows an apparatus designed to make use of this principle. Here *F* is the laminated field ring or primary of a rotary field motor, the secondary of which is wound upon the rotatable core, *E*, mounted on the shaft, *D*, within the gas-tight shell, *A*, which is closed by the insulated and gas-tight cover, *B*. The rotating field of force obviously acts through the shell, *B*, which should be an insulating material or high-resistance metal, and rotates the parts within which carry a crown of downwardly pro-

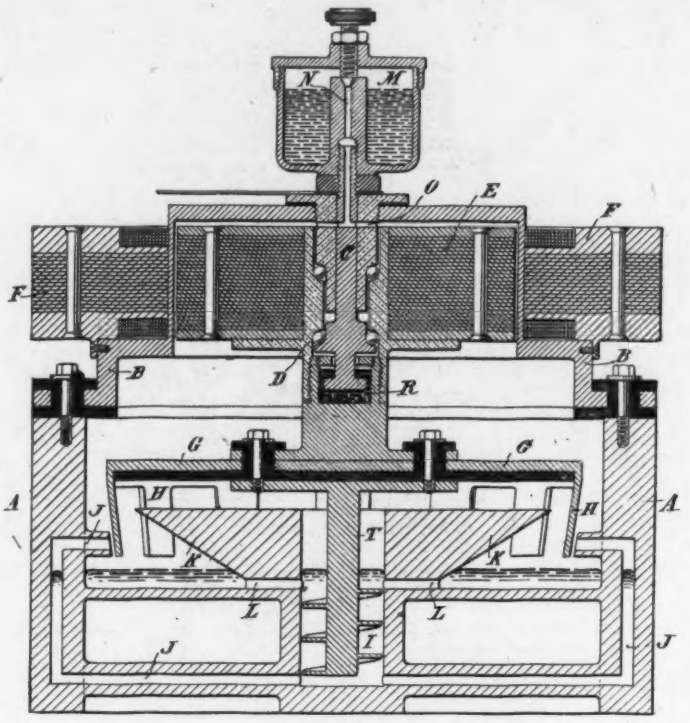


Fig. 4.

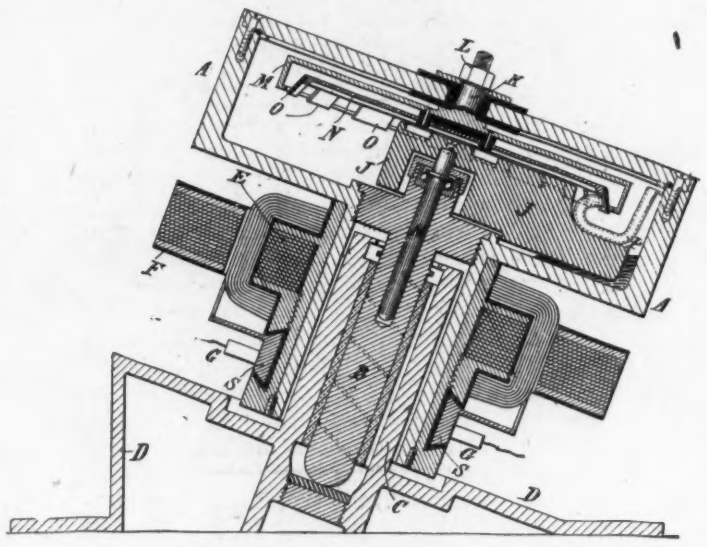


Fig. 5.

jecting teeth, *H*, and on the lower end of the shaft a screw pump, *I*. This screw pump acts upon the mercury in the lower part of the vessel, forcing it outwardly through tubes, *J*, from which it emerges in jets against the teeth, *H*; these jets and teeth make and break the circuit as in the apparatus described above, the whole being kept under pressure by an inert fluid shown in the cup, *M*, at the top of the apparatus; this liquid may be such a one as anhydrous ammonia, giving, at ordinary temperatures, a high pressure, due to its restricted evaporation and low boiling point. The gas is carried down into the chamber through the tube, *N*, in the fixed internal part of the ball bearing, *C*.

A means of accomplishing the same result without the use of a magnetic field acting through a fixed gas-tight wall, utilizing instead the force of gravity, is shown in Fig. 5, where *A* is again a gas-tight case supported upon an inclined spindle, *B*, and arranged to be rotated by a direct-current motor with outside armature similar to that shown in Fig. 2. Within this case is an eccentric weight, *K*, mounted on a self-oiling spindle, *J*, with a ball thrust bearing to avoid its being dragged around by friction. Owing to the inclination of the rotating axis of the system from the vertical, this weight, *K*, tends to remain at the low side and not to revolve with the case. Attached to this non-rotating weight, *K*, is an arm, *L*, carrying another ball bearing shaft, *N*, supporting a

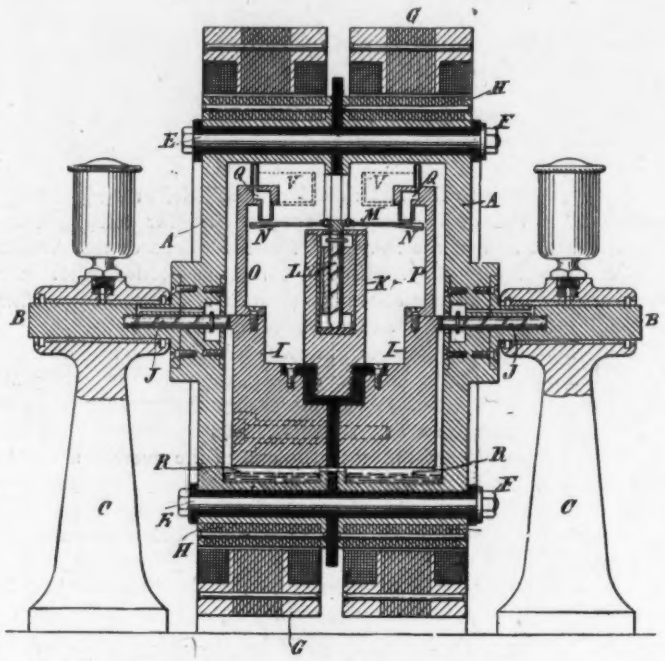


FIG. 6

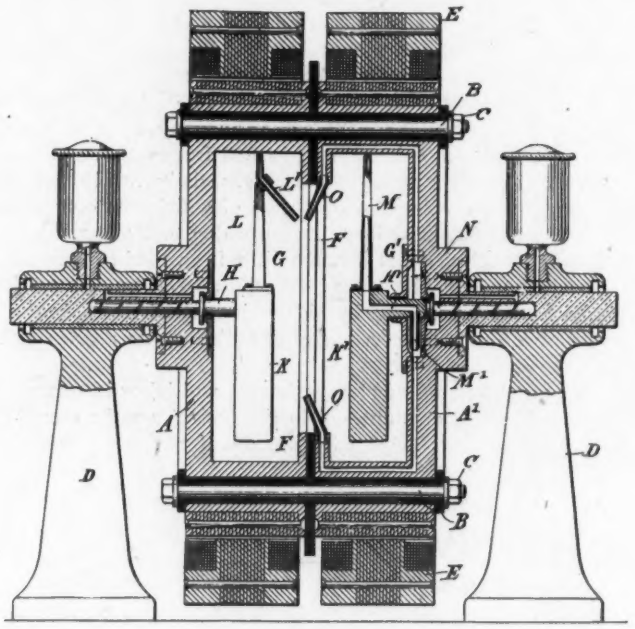


FIG. 7.

number of vanes, *Q*. When the case is revolved the mercury contained therein is maintained by centrifugal force in the form of a ring against the outside wall, into which ring the vanes, *Q*, dip and are rotated at high speed, making and breaking a contact between themselves and the mercury.

Still another device for obtaining a rapid make and break in a gas-tight chamber, this time utilizing both the rotary field and the eccentric weight, is shown in Fig. 6, where *G G* are two stationary primaries of the induction motor, which in this case is arranged in a vertical plane of rotation, *H H* being two secondary rotors, the necessity for two elements being the division of the rotating part by insulating gaskets into two sections. Within this rotating chamber, *A*, are mounted two eccentric weights, *I I*, fastened together by an insulating joint and supported on the spindles, *J J*. Fastened also to them is the central vertical journal, *K*, in which rotates the spindle, *L*, carrying a wheel, *M*, and inclined helically bent blades, *N N*. As before mercury placed in the revolving case is carried around by centrifugal force and, meeting the spouts attached to the nozzles, *Q*, is driven by its own inertia through them against the blades, *N N*, which, owing to their inclination, are given a rapid rotary motion about the spindle, *L*. The claims of novelty made for this combination are the facts that the action of the jets themselves puts in motion the solid terminals of the make and break device, with a speed very high compared with that of the shell, and that the motion of the vanes acts gyroscopically to prevent oscillation (and hence variation of the frequency) of the eccentric weights, *I I*.

A similar make and break device, in which, however, both terminals are liquid jets, is shown in Fig. 7. Here, as in Fig. 6, are the two rotary field motors rotating in a vertical plane with eccentric weights, *K K'*, the scoop attached to the former directing a jet from the nozzle, *L'*. The scoop attached to the other is intended to direct the liquid through the tube, *M*, to the axis of rotation, whence it is distributed through passages in the rotating case to the nozzles, *O O*. These jets striking that from *L'* make and break the circuit between the two insulated halves of the shell,

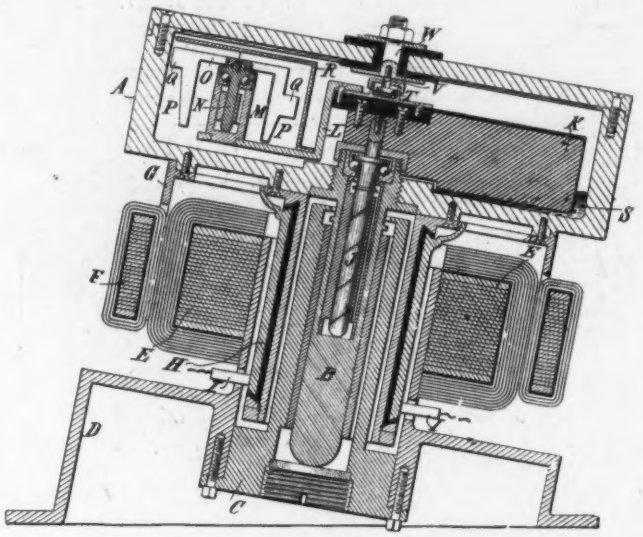


FIG. 8.

thus giving liquid contacts at both terminals of the make and break device.

Another interesting variation of the inclined axis arrangement shown in Fig. 5, giving mercury terminals in another way, is shown in Fig. 8, the essential features of which are a rotating shell, *A*, eccentric weight, *J*, carrying a tube, *P*, with scoop and nozzle and an unbroken solid metal terminal, *M*, with which the mercury makes contact. Rotating with the shell is a crown of downwardly projecting teeth, *O O*, these teeth being in this instance insulators preferably non-organic and vitreous. These insulating teeth cut off the stream of mercury intermittently, giving a rapid make and break with mercury terminals.

A further modification by which higher frequency is obtained is shown in Fig. 9, the frequency being doubled by means of rotating both terminals of the make and break device in opposite directions. This is effected by means of one rotary field generated by the primary, *H*, actuating the rotatable secondary, *G*, which carries on spindle, *C*, the gas-tight shell, *D*, through the upper part or cap of which, *F*, still another rotary field acts upon the secondary wound upon *Q*, which in turn is rotatable on spindle, *P*, and carries by means of arms, *T*, the mercury scoops and jets, *V*. These move in one direction while the teeth, *L L*, rotate with the case, *D*, in the opposite direction, thus giving double the frequency obtainable with the same angular velocity and one member stationary.

A most curious modification is shown in Fig. 10, in which the winding of the secondary of one of the elements, instead of being a copper short-circuited squirrel cage, as in the induction motors described above, consists of the mercury itself, this being arranged

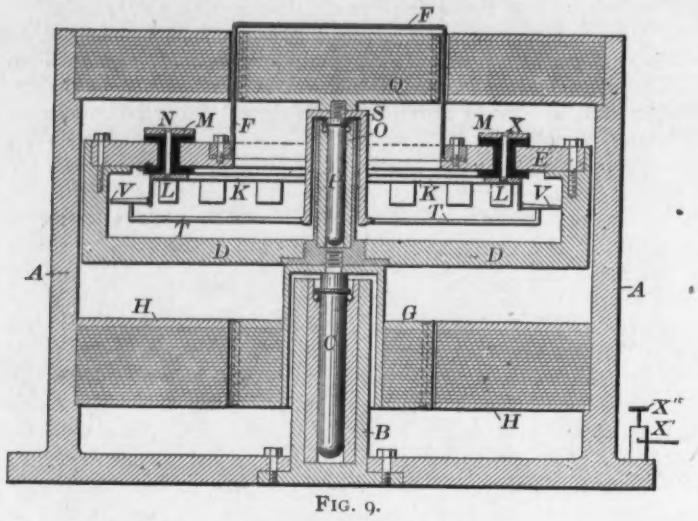


Fig. 9.

in two rings, *B B'*, forming the two terminals. A powerful rotating field, generating Foucault currents in these rings, will rotate them with a high velocity, the field completing itself through the stationary core, *E'*. Above is another rotary field actuating the secondary, *N'*, which carries the star wheels, *L' L''*, whose teeth

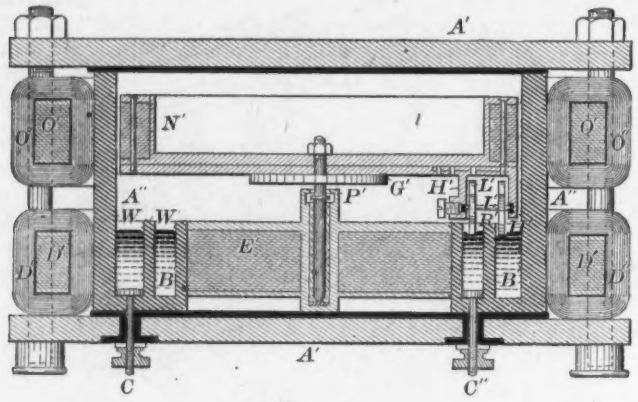


Fig. 10.

dip into the mercury rings below. The element carrying these wheels is supposed to rotate in the opposite direction from the rings of mercury, giving the star wheels a high peripheral velocity and a correspondingly high frequency of make and break.

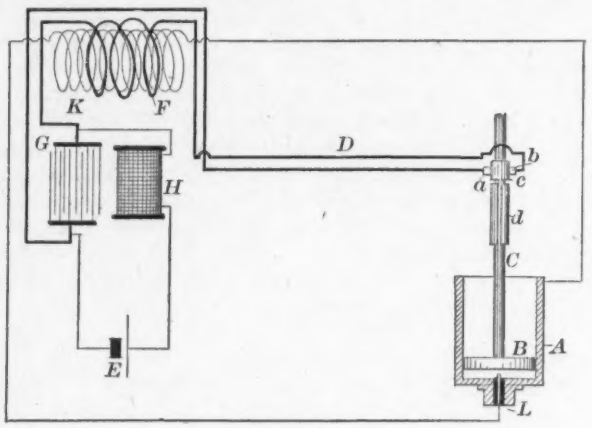


Fig. 11.

Another patent issued simultaneously with those described above and by the same inventor covers an improvement in electrical igniters for gas engines, as shown in Fig. 11, the principle being the use of an oscillatory discharge in the cylinder of the engine, the primary impulse being obtained at the proper instant from a contact actuated by the motion of the engine parts.

In the figure, *E* is the source of current, *H* an inductive coil, *G* a condenser, and *K* the transformer; at *a* is shown the contact for short-circuiting the primary and condenser at the proper time, thus causing a discharge from the secondary between the terminal, *L*, and the piston, *B*.

Remarkably broad claims on these various mechanical combinations have been obtained, the most important being briefly as follows: a rotating receptacle and independently mounted terminal, making contact with the fluid therein; a jet making contact with spaced conductors in combination with self-contained means for maintaining a circulation of the fluids (the use of a jet contact being well known in the art was not broadly patentable); an interrupter surrounded in a closed receptacle by an inert insulating medium under pressure; the use of jets for both terminals and the use of a jet intercepted intermittently by insulating solids.

The Introduction of Hard-Drawn Copper Wire.

The Committee on Science and the Arts of the Franklin Institute has awarded a medal of merit to Mr. Thomas B. Doolittle, of Branford, Conn., for his efforts in advancing the use of hard-drawn copper wire.

The report refers to the fact that Mr. Doolittle, in the year 1877, suggested the use of hard-drawn copper wire for telephone and telegraph uses, and in the same year, at the works of the Ansonia Brass & Copper Company, Ansonia, Conn., succeeded, after many experiments, in producing about 500 pounds of this material, which was employed on a telephone line connecting these works.

The method, which is now well known, consists in using drawing-plates containing a larger number of holes than the ordinary plates used in copper wire drawing, and increasing the number of passes for a given reduction of area. By this means it is possible to draw copper wire from the beginning to the end of the operation without any annealing, and at the same time to avoid the crystallizing of the metal. The wire thus produced is sufficiently flexible to permit of the formation of standard telegraph wire joints without breaking or cracking.

The hard-drawn copper wire made by the Doolittle method has its tensile strength doubled and its elongation reduced to about 1 per cent., while its electrical conductivity is not materially impaired.

The report dwells upon the great utility of such hard-drawn copper wire for aerial conductors on account of its high conductivity and great tensile strength and reliability in prolonged service, which were amply demonstrated by Mr. Doolittle in his efforts to secure its adoption by the electric line builders; and it was due entirely to his persistent endeavors that hard-drawn copper wire was at length adopted for telegraph and long-distance telephone purposes.

Hard-drawn copper wire has now become a staple article of manufacture, not less than 80,000,000 pounds having been produced in the United States alone in 1896. It is now frequently employed for all kinds of electric conductors, and especially for long-distance telephone lines, the successful operation of which, the committee of investigation admits, is in large measure due to its introduction.

The report concludes that Mr. Doolittle is entitled to recognition:

(1) For having been the first to recognize the value of hard-drawn copper wire; and for having, by his persistent endeavors, in the face of adverse conditions, succeeded in establishing its use for electric conducting wires; and

(2) For his long-continued experiments and labor in overcoming the many difficulties encountered in producing, on the commercial scale, a hard-drawn copper wire suitable for electric conducting wires.

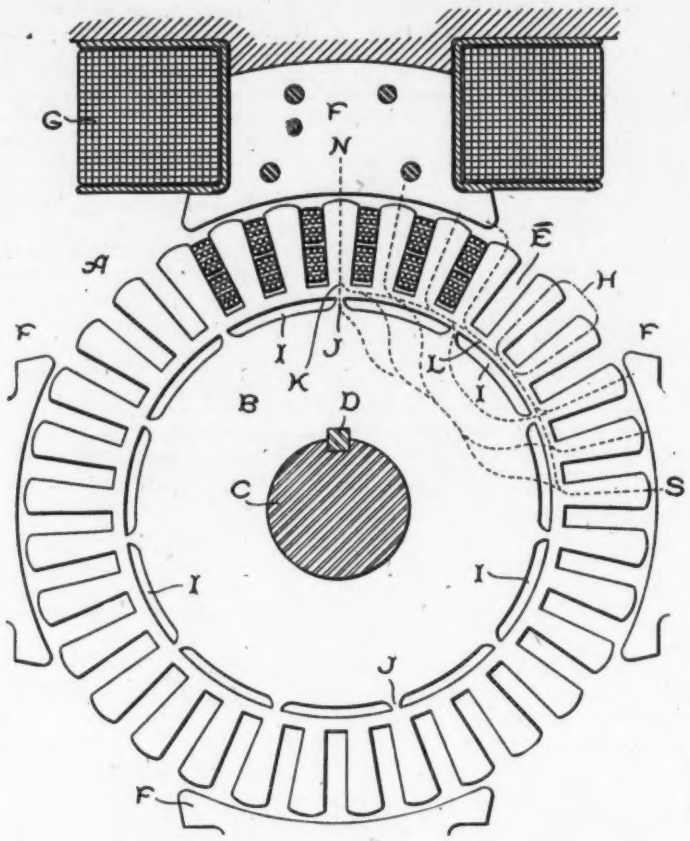
An Acceleration Indicator.

In a paper read before the Engineers' Club, of Philadelphia, Mr. Wilfred Lewis describes an indicator for measuring the horizontal effort applied to traveling cranes, the purpose of the measurement being a determination of the necessary lateral strength of the runway. The instrument, when calibrated, makes a most simple device for measuring the acceleration or retardation of cars or trains. It consists of a tube somewhat similar to a spirit level, but curved somewhat more than the instrument, the curve being greater for the measurement of higher accelerations. Properly calibrated it can be made direct-reading whenever placed in a horizontal position, and can be properly corrected for grades if their inclination is known. With an increasing study of the train motion problem a simple indicator of this kind will probably prove to be a valuable instrument.

The Reduction of the Self-Induction of Armature Coils.

Patent No. 608,277, issued to E. H. Anderson and D. P. Thomson, of the General Electric Company, on August 2, 1898, describes an ingenious method of reducing the self-induction of armature coils and hence the tendency to spark at the brushes.

By the construction claimed in this patent and shown in the accompanying illustration it is proposed to increase the reluctance of the local magnetic circuit in the teeth and around the slots without proportionately increasing the reluctance of the main magnetic circuit through the armature and fields. This is accomplished by providing air gaps, *I I*, in the laminated armature core separated only by bridges, *J J*, for mechanical strength. The effect of these air gaps is to cause the main flux entering the armature teeth from any pole, as *N*, to divide between two paths to the teeth under pole *S*, one path being between the bottoms of the slots and these gaps, *I I*, and the other across the latter gaps and through the main body of the core *B*. The latter path, in which the lines of force are compelled to crowd into the junctions, *J*, or cross two air gaps, *I I*, is



AN AIR-GAP ARMATURE CORE.

of comparatively high reluctance, crowding the alternative path, *L*, between the slots and the gaps, *I I*, which is of comparatively small cross section, to a high magnetic density. On account also of the large cross section in the core plate between the shaft and the auxiliary gaps, *I I*, the density in this part is comparatively low.

By this arrangement the path of the local lines of force, such as *H*, up one tooth across to the next tooth, down the latter and completing itself under the bottom of the slot, is already crowded, or saturated at the latter point with the lines of force from the main field, and its cross section at that point is also considerably reduced, for both of which reasons the magneto motive force tending to set up the local self-inductive flux around the armature coil has a comparatively small effect.

A similar principle has been used hitherto, especially in railway motor work, by reducing the radial depth of the armature core from the slots to its inside face, and thereby running up the density of the magnetic flux in this portion and reducing the self-inductive effect of the teeth by crowding out, so to speak, the local lines of force tending to complete themselves around the slots. This requires, however, the working of all the iron in the armature core at a high density and increases considerably the iron losses. By the improved construction proposed in this patent, only the narrow rim of the core immediately under the slots is run at a high density, the main body being worked at a comparatively low density.

The specification of the patent describes a comparative test of two armatures, one provided with a narrow core and the other with the improvement described in the patent, which is aptly termed "an air gap core," both armatures being of the same size and similarly wound. The tests showed that the core loss of the former amounted to 2350 watts and that of the improved core amounted to 1550 watts, the maximum efficiency of the air gap core motor being 2 per cent. greater than that of the other.

A New Use for Electric Heat.

The boring of the tunnel for the Jungfrau railroad, in Switzerland, has been progressing steadily in spite of the severe climate of the high Alps in winter, and as electricity is used not only for light and motive power, but for heating as well, where this is necessary, some new developments in the heating line have been worked out with great success. One of them is the warming of high explosives.

On this work blasting gelatine is used, an explosive which freezes at about 40° Fahr., and which is, in its frozen condition, very dangerous to handle, being unlike dynamite in this respect. The contractors who are blasting out the Jungfrau tunnel keep their explosive in a sort of safe heated by electricity so that the danger of the gelatine freezing is entirely obviated.

Dynamite or some other derivative of nitroglycerine is in very common use for blasting and other purposes, and is commonly frozen for safety, as this explosive is very inert at low temperatures. It is usual to thaw it out before it is used, and scarcely a week passes that the newspapers do not chronicle an accident from carelessness in the use of heat for this purpose. A dynamite thawer operated by electricity would be safe and perfectly regulable, as well as very convenient in use, and some manufacturer of electric heaters might find it worth while to investigate the needs of those using the explosive.

Society for the Promotion of Engineering Education.

The sixth annual meeting of this society was held in Boston, August 18, 19 and 20, in connection with the Convention of the American Association for the Advancement of Science. The following papers of interest were read:

President's Address, by John B. Johnson; The Mutual Adjustment of Class-room and Laboratory Instruction, by Gaetano Lanza; The Mounting of a Spherical Blackboard, by A. E. Haynes; Notes on the Organization of an Engineering Laboratory, by H. B. Smith; The Correct Theory and Method of Organization and Conduct of Professional Schools, by R. H. Thurston; Report of the Committee on Entrance Requirements, by H. W. Tyler, chairman; Some Phases of Engineering Education in the South, by J. J. Wilmore; Report of the Committee on Uniformity of Symbols, by T. C. Mendenhall, chairman; The Study of Electricity in Courses Other than Electrical, by J. P. Jackson; A Course in Industrial Chemistry for Technical Schools, by F. L. Dunlap; A New Laboratory Apparatus for Illustrating Longitudinal Impact, by W. K. Hatt; The Direct Study of Thermodynamics, by S. A. Reeve; Laboratory Instruction in Electrical Engineering, by R. B. Owens; A Course in Highway Engineering for Civil Engineers, by W. R. Hoag; Notes on some Methods in Use in an Engineering Laboratory, by F. C. Caldwell; Sanitary Science as a Part of Every Science Course, by W. T. Sedgwick; The Conduct of Thesis Work, by Edgar Marburg; The Construction of Models by Students as an Aid in Teaching Descriptive Geometry, by H. S. Jacoby; The Training of Engineers for the Maintenance of Way Department on Railroads, by J. C. Nagle.

A Benevolent Fund for Electrical Engineers.

The Institution of Electrical Engineers of England has established a benevolent fund for the benefit of needy members and their families, or the families of deceased members, the amount so far collected having been about $5000. The donations and subscriptions are to be considered as capital until the sum of $50.000 has been invested, the interest of which will be distributed as mentioned. the names of recipients being kept secret.

DIGEST OF CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," July 29.—A continuation of their long serial. The leakage coefficient is discussed; this coefficient is the number by which the flux which reaches the armature and becomes linked with the armature turns must be multiplied in order to give the total flux generated by the field coils; it is in most cases considerably greater than unity, and should increase with the load. Six diagrams give the values of these coefficients as determined from actual measurements in a number of different types of machines, some with and some without current in the armature; they give the coefficients in different parts of the frames. The armature core reluctance is generally fixed by thermal conditions, depending on the density and the periodicity, the reluctance being chosen as high as is consistent with the permissible core loss. The air gap reluctance is briefly discussed; it is determined by the space required by the armature conductors and the necessary mechanical clearance; it is frequently asserted that the sparking limit is a function of the depth of the air gap, and this is true in so far as this depth affects the inductance of the coils under commutation, but experiments show that the inductance of the armature coils in many cases is appreciably diminished by increasing the depth of the air gap, and the latter, therefore, has no relation in these cases to the magnetic sparking output; all the conditions which they mention may be included broadly by saying that for a given output there is a certain minimum reluctance in the air gap having regard both to the distortion and self-induction; sparkless commutation should be considered not only in its relation to the inductance of the armature coils and the strength of the reversing field, but also with respect to the nature of the collecting brushes; generally speaking, visible sparking external to the brushes is least injurious to the commutator. The gap reluctance is next discussed; the magnetomotive force expressed in ampere turns, expended in maintaining a flux of D lines per square inch across an air gap of length L in inches, is equal to $0.313\ D\ L$; the proof of this is given. The reluctance of the core projections is then discussed, and the importance of the magnetic forces required for a given flux across this part of the magnetic circuit is pointed out; a method of calculating it is described, but cannot be reproduced here; auxiliary tables and curves are given; in practice the width of the tooth is generally from 50 to 80 per cent. of the width of the slot; 25 per cent. of the length of the armature is frequently taken up by the insulation and ventilating ducts; although the iron path through the teeth has a higher permeability the air path has sufficiently greater cross-section that it takes a considerable portion of the flux; the magnetomotive force required may be greatly less than that for sending the entire flux through the projection.

MAGNETIC LEAKAGE IN DYNAMOS. Sumec. "Elek. Zeit.," July 28.—A short analytical discussion. If the magnetic leakage with two opposing magnetomotive forces is treated analogously to a case of electric currents, then the Kirchhoff laws give the same results as the well-known Blondel-Heyland diagrams. He applies this to the case of the induction motor in which the leakage is of more importance than in any other apparatus. He also shows a polar diagram, which represents the equations which he deduces; it is identical with Heyland's diagram.

DYNAMOS. Guilbert. "L'Eclairage Elec.," July 30.—Illustrated descriptions of recent improvements taken from patent specifications.

Lights and Lighting.

IRON-NICKEL ALLOY FOR LEADING IN WIRES.—"Zeit. f. Beleucht.," July 30.—A note stating that an alloy containing 40 per cent. of nickel has the same expansion coefficient as platinum; samples of this wire have been carefully tested by the Reichsanstalt, and the claims have been completely substantiated.

NERNST LAMP.—"Zeit. f. Beleucht.," July 30.—A note stating that Nernst has found a new, strong and cheap heating material to be used for automatically heating the body, which then becomes a conductor whose incandescence is maintained by the current; it is claimed that the want of this was the only objection to Nernst's new lamp (which was recently described). No further information is given.

Power.

SEWING MACHINE MOTOR.—"Elec. Eng.," August 4.—A brief, illustrated description of a German sewing machine in which the motor is mounted directly on the axle instead of being belted as usual; the motor consumes only 0.7 ampere at 110 volts, and has a speed of 1000 revolutions.

POWER DISTRIBUTION IN FACTORIES. Mavor. "El'ty," August 10.—A reprint of the abstract noticed in the "Digest" last week.

Traction.

ELECTRIC TRACTION IN SWITZERLAND.—"L'Eclairage Elec.," July 23.—A full-page table of statistics with a short descriptive text. In 1897 the total length of electric railways was 110.5 km (about 66 miles); on 14.2 per cent. in length steam power was used, on 64.5 per cent. water power and on 21.3 per cent. gas power; all the lines, without exception, are operated by the trolley system. There are 12 lines under construction, representing a total length of 103 km, and twenty-five lines, representing 323 km, have been projected. The number of km of line per unit of population is probably the greatest of that on the continent.

ACCUMULATOR TRACTION IN PARIS. Drouin. "L'Eclairage Elec.," July 30.—An abstract of a paper read before the French Society of Civil Engineers on the rapid-charging system used in Paris; the abstract is very brief, and gives but little information. The total weight of a car is 14 tons, of which 3600 kg is the weight of the accumulators. He refers to experiments made to determine the traction resistance; the car was started on a level or known grade and the current then cut off; by means of a contact on the axle the distance run over was recorded on a chronograph cylinder, as a function of the time, and from this the traction resistance was then calculated. It was found that this resistance, including the revolving of the motor unloaded, between the values of 5 and 25 km, is given by the formula that the traction resistance in kg per ton is equal to 3 plus the product of the speed in km per hour, times 0.16.

MIDDLESBROUGH.—Lond. "Elec.," July 29.—An illustrated description of the electric road from this town to Stockton and Thornaby. See THE ELECTRICAL WORLD, August 6, 1898.

BRADFORD.—Lond. "Elec. Rev.," July 29.—An illustrated description of this municipal tramway, which has just been started.

AUXILIARY ELECTRIC LOCOMOTIVE.—"Elek. Anz.," July 28.—A note stating that, according to "Génie Civil," the Northern Railway of France is considering the construction of a locomotive which is to be attached to the trains drawn by steam locomotives; it contains a battery of accumulators and a motor; when the train is running down hill the motors are made to charge the accumulators, and the energy stored in them is then to be used to assist the train up hill.

TRACTION MACHINERY. Chenet. "L'Ind. Elec.," July 25.—Illustrated descriptions and results of tests made with the motors and controllers of the Steel Motor Company, which are said to be used largely in America; these are claimed to be the first tests of these motors made in that country.

CAST-WELDED RAIL JOINTS.—Lond. "Elec.," "Elec. Eng.," "Elec. Rev.," July 29, and Lond. "Lightning," July 28.—An illustrated description of this (American) method as applied to an English railway.

CONTROLLER.—Lond. "Elec. Rev.," July 29.—An illustrated description of an improved controller intended to be used on electric vehicles, including also motor cars. The handle is like that of a spade, and it is operated by twisting it; the advantages claimed are simplicity, ease and quickness of breaking the circuit, and reliability of contact. It is thought to be often necessary to start at a quick speed, and this can be done with this controller, in which the circuit is broken by merely depressing the handle or completed by raising it, both without interfering with the speed combination. It has no drum, all the contacts being on a slab perpendicular to the shaft. It is known as the Elieson-Naylor controller.

AUTOMOBILES. Reyval. "L'Eclairage Elec.," July 23 and 30.—Illustrated descriptions of the Milde-Mondos carriage and delivery wagon, and of the Patin carriage, all of which were exhibited at the recent exhibition in Paris.

CHARGING STATION FOR AUTOMOBILES.—"Elec. Eng.," August 11.—A brief, illustrated description of one of the charging stations in Paris, showing also the light, portable, switchboard with its meters, rheostats, signals and connections; it appears that the batteries are charged on the carriages, while in this country they are replaced by fresh ones.

AUTOMOBILES.—"Elec. Eng.," August 4.—An abstract, with a number of illustrations, of the article noticed in the "Digest" August 6.

Installations, Systems and Appliances.

STANDARDIZING ELECTRIC PLANTS.—Lond. "Elec. Rev.," July 29.—An editorial criticism of the recent report to the Amer. Inst. Elec. Eng. by its committee; the comments are very limited. No reason is seen why bearing friction should have been singled out as not being measurable, as it is just as difficult to measure some of the other losses; it had better have been combined with other losses. It is not stated how the brush friction and contact losses should be measured; it is not clear why the loss in the regulating rheostat should not be included in separately excited ma-

chines as it is in the self-excited; the whole energy required to drive the exciter should be debited to the separately excited machine. It is thought preferable to determine the efficiency under load by driving the machine as a motor, the efficiency of which has already been determined. The position of the thermometer in the room will greatly affect the temperature measurements. The duration test for determining the dielectric strength is thought to be too short, as there are cases where some apparatus stood the high pressure test for more than five minutes, but broke down in fifteen; a half hour is suggested instead of five minutes, and it is thought that 1.5 times the working pressure for half an hour instead of two or three times that pressure for five minutes, would be better. In the Board of Trade Rules the draught rules, after discussion, were changed so as to reduce the test voltage to 1.5 times, in place of twice, the working voltage. It is thought a pity that the standard voltages for alternating-current systems should not have been the same as those for continuous currents; also that the higher ones are not multiples of the lower.

DISTRIBUTION OF ELECTRICITY IN EUROPE. Lauriol. "L'Eclairage Elec.," July 30.—A very long abstract (fourteen pages) of his report to the municipality of Paris on his examination of the electric lighting systems of the principal cities of Europe, to aid in the adoption of a scheme for Paris; a list of the cities visited is given, together with references to the numbers in that journal, in which descriptions of the respective plants have been published. In the last part is a similar, although much more brief, report on street railways.

OFFICE-BUILDING PLANT.—"West. Elec.," Aug. 6.—An illustrated description of the light and power plant in the Land, Title and Trust Building, the tallest office building in Philadelphia. The Arnold quill-drive system is used to enable either engine to run either one or both dynamos; there is also a storage battery plant, which is so connected that the charging circuit is independent of the discharging one. See THE ELECTRICAL WORLD July 9, 1898.

BOSTON.—"Elec. Rev.," August 10.—A reprint of the annual report of the Boston Electric Light Company.

Wires, Wiring and Conduits.

RULES AND REGULATIONS.—"Elek. Zeit.," July 28.—A reprint of the adopted German rules and regulations for high-tension insulators in which the voltage between any two wires is 1000 or over. It concludes with a table of simple diagrams to be used as conventional signs in drawings; these are all remarkably simple and easily drawn.

Electro-Physics and Magnetism.

COHERER. Arons. "Wied. Ann.," No. 7; abstracted briefly in the Lond. "Elec.," July 29.—He studied the occurrence in coherers under the microscope in order to find what change takes place when it responds to an electric wave. On exposure to waves a full contact was as a rule immediately produced; violent commotions and a play of sparks were observed; there was a destruction of contacts by a repetition of the vibrations which produce them; in all cases the coherers showed signs of wear after repeated use, especially those of the embedded type.

MOTION OF THE ETHER. Wien. "Wied. Ann.," No. 7; abstracted briefly in the Lond. "Elec.," July 29.—A valuable review of the present state of the ether problem, with special reference to the question of whether it is movable or not.

FLAME GASES; HIGH CHIMNEYS. Wesendonck. "Wied. Ann.," No. 7; abstracted briefly in the Lond. "Elec.," July 29.—High factory chimneys are relatively less subject to damage by lightning; he made some observations in which he reproduced as closely as possible the conditions in question, in order to find whether this is due to the hot gases. It is concluded to be nearly certain that flame gases are not the causes of the immunity of chimneys, though they may be an indirect cause by producing an ascending current of air.

WAVES IN METALLIC INCLOSURES. Branley. "L'Eclairage Elec.," July 23.—A reprint of an Academy paper in which he shows that a metallic envelope does not allow Hertzian oscillations to traverse it; the passage of such oscillations is very much easier through long openings, even very fine, than through bored holes; the length and direction of the opening takes an important part.

LAW OF INDUCTION. Breslauer. "Elek. Zeit.," July 28.—A reprint of a paper read before the German Union of Electrical Engineers. There are two well-known laws concerning the induction of a current in a wire, one being based on the cutting of lines of force and the other on increasing or diminishing the number of lines inclosed by a loop; while in practice either may generally be used, there are, he claims, important limits of each, and in these cases only the other law can be used; moreover, under certain circumstances one of them is claimed to lead to very incorrect results; one of them fails in the case of unipolar machines, and the other in the case of transformers, there being no loop in the former, while in the latter no lines of force are cut. With the aid of simple mathematical relations he then deduces a single law which he claims includes both of the others; the area inclosed by the wire should not be the whole area of the loop, but only that part which is traversed by the lines of force; he offers the following law: An electromotive force is produced when the number of lines of force increases or diminishes in the area described by the wire, whether by its motion or by its form; this, he claims, covers all the cases. He shows a case in which he claims one of the original laws leads to quite incorrect results, the case being that of a single loop on a drum armature in which a direct current would be produced by a uniform motion, if the field were suddenly reversed while the wire was in its neutral position. (As was explained some years ago by the compiler, the unipolar machine may be explained by the theory of the inclosed lines of force, by assuming that the sliding brush contacts are the equivalents of an elastic wire capable of being indefinitely stretched or of wires which are being wound up on the shaft. The case of the transformer can be explained by the assumption that the lines of force move outward from the wire which produces them, when they are formed, and moved in the reverse direction, vanishing in the wire which produced them, when the current becomes zero.)

ELECTRIC RESISTANCE OF STEELS. Chatelier. "L'Ind. Elec.," July 25.—A reprint of the Academy note noticed in the "Digest" July 23.

ARC BETWEEN ALUMINUM ELECTRODES. Lang. "Wied. Ann.," December; abstracted briefly in "L'Eclairage Elec.," July 30.—He determined the counter E. M. F. of the arc between aluminum electrodes.

X-RAYS. Smith. Lond. "Elec. Eng.," July 29.—A short article in which he claims that there is some connection between the materials used for the anodes and cathodes, and the material which is to be examined by means of the X-rays. Every element or combination gives a certain definite ray or tint; whatever this tint or ray when heated in the Bunsen burner, it will be the same when given off in the X-ray tube; the vapor ray given from flesh is yellow-green, and the yellow-green ray from the platinum must therefore pass through the flesh, but not the bone; if the ray should penetrate the bone the anodes and cathodes should be made of a compressed phosphate of lime or a clean piece of bone; if it is desired to see through steel the electrodes should be steel, brass for brass, etc. (It appears to be merely a suggestion, as no proofs are given.)

DARK CATHODE SPACE. Wehnelt. "Wied. Ann.," No. 7; abstracted briefly in Lond. "Elec.," July 29.—He investigated the nature of the discharge in the dark cathode space, by means of a coherer. The results go to prove that the discharge through the dark space has a disruptive character, just as though this space was a dielectric like paraffin oil.

DISCHARGE BY X-RAYS. Sagnac. "L'Eclairage Elec.," July 23.—An Academy note on the mechanism of the discharge by X-rays.

ATMOSPHERIC DISCHARGES. Montel. "L'Eclairage Elec.," July 30.—When lightning strikes near a closed circuit the latter becomes the seat of a temporary current, representing a certain amount of power; in the present article, which is of a theoretical and highly mathematical character, he discusses the power developed in that closed circuit; this is based on the known laws of discharge of condensers. He concludes that if in the case of an atmospheric discharge it is possible to measure two integral values of the square of the current by the differential of the time induced in each of two circuits, in one of which the ratio of the resistance to the coefficient of self-induction is very small, while in the other it is very large, it becomes possible to find out, by comparison of these two integrals, the nature of the atmospheric discharge.

EARTH CURRENTS.—"Zeit. fuer Elek.," July 31.—A short article of a general character. Extended researches were made by the Sodankyla polar expedition; the results arrived at were similar to those made by Wild—namely, that the earth currents at short distances of 1 km are not continuous currents of variable intensities, but change their directions; the component in the east-west direction is in general larger than in the north-south direction. It cannot be stated whether the earth current is the cause of the earth's magnetism even though there may be a connection between the two; Lemstroem supposes that the earth is like the iron core inside of a coil through which a current flows, and in this way explains the observations. There are, however, variations in the earth currents which do not coincide with those of the earth's magnetism, and vice versa; the magnetic variations which do not correspond to those of earth currents may be caused either by earth currents in other parts of the earth or by atmospheric currents.

MAGNETIC VISCOSITY. Klemencic. "Wied. Ann.," 63, p. 61: abstracted briefly in "L'Eclairage Elec.," July 23.—Descriptions of his researches made with intense fields, former observations having been made only with rather weak fields. The viscosity depends on the magnitude of the variation of the field and follows the same law, whether this variation is due to the reversing of the current or to the opening or closing of the circuit; its absolute value increases with the intensity of magnetization, and tends toward a maximum, which is reached probably before the maximum of magnetization.

ELECTRIC AND MAGNETIC WIND. Lehman; Arrhenius; Warburg. "L'Eclairage Elec.," July 23.—Very long, illustrated abstracts of three articles from the "Wied. Ann.," 63, p. 285, 305 and 411, respectively; some of these have already been referred to in the "Digest."

MAGNETIC PROPERTIES OF STEELS. Mme. Curie. "L'Eclairage Elec.," July 23; abstracted, with curves and tables, from the "Bull. Soc. d'Encouragement p. L'Ind. Nat.," 3, p. 58.—

She studied the magnetic properties of tempered steels in the form of rings; the hysteresis curves and the data are reproduced in the abstract for five different kinds of steel. She found the agreement was not as good as in the case of bars, and therefore gives a preference to investigations made with the latter. The intensity of remanent magnetization increases at first with the percentage of carbon and reaches a maximum for 0.5 per cent., after which it decreases; the hysteresis increases with the percentage of carbon; the addition of various other metals changes the intensity of remanent magnetism of these rings only slightly; it increases the coercive field and the hysteresis and diminishes the maximum induced magnetization.

DISCHARGES IN MAGNETIC FIELDS. Paalzow and Neesen. "Wied. Ann.," December; abstracted in "L'Eclairage Elec.,' July 23.—Descriptions of researches made to study the influence of the magnetic field on the intensity of the discharge in rarefied gases.

INFLUENCE OF SHOCKS ON MAGNETIC SUSCEPTIBILITY. Fromme. "Wied. Ann.," 63, p. 314; abstracted in "L'Eclairage Elec.," July 23.—He studied the effects of electric oscillations and mechanical shocks on the magnetic susceptibility.

MAGNETIC SCREENS. Du Bois. "Wied. Ann.," 63, p. 348; abstracted in "L'Eclairage Elec.," July 23.—He calculates the effect of spherical or double cylindrical envelopes such as are used for the protection of galvanometers.

ZEEMAN PHENOMENON. Righi. "Rend. Accad. Lincei.," June 11; reprinted in "L'Eclairage Elec.," July 23.—A kinematic interpretation of this phenomenon.

CATHODE JETS. Phillips. "El'ty," August 10.—A reprint of the article noticed in the "Digest" last week.

Electro-Chemistry and Batteries.

OZONE. Kershaw. Lond. "Elec. Rev.," July 29.—A short article in which he gives brief descriptions of the different forms of ozonizers now before the public, and examines the financial aspects of the use of ozone for various purposes. Andreoli's ozonizer is of the open type, the air being in direct contact with the metallic electrodes, which are made of aluminum (this has recently been referred to in the "Digest"); they work from the secondary of a transformer the current in which is 0.13 ampere at 2800 volts; it is said to yield 125 grams of ozone per kw hour; no cooling is required, but the air must be perfectly dry and free from dust. The Otto apparatus is composed of a thin sheet of metal laid on a sheet of glass or fixed between two glass plates; in the oblong form the air enters at one end and travels in a zig-zag manner between the electrodes; in the circular form it enters at the centre and passes away at the circumference (an illustrated description of his apparatus is published in the "Zeit. f. Elektrochemie," July 28); his chief discovery is said to be the fact that the output of ozone is proportional to the frequency of the current; it is also stated that the output per electrical hp-hour is a maximum for a frequency of 80; he then obtains 155 grains of ozone per electrical hp-hour. The Yarnold apparatus consists of a flat-shaped box containing horizontal glass plates coated with gold leaf on one side, the films being connected alternately to the two poles of a transformer; the air does not come in contact with the films; the voltage is 15,000, and the frequency 83; no cooling is required; the yield is claimed to be 175 grams per electrical hp-hour. The Siemens and Halske apparatus consists of a number of concentric tubes, one of metal and the other of glass, coated on the opposite side with tinfoil; water is led through the inner tube to keep down the temperature, and the air is passed between the inner metal and the outer glass tube; the output is 20 grams per electrical hp-hour; it has been in use since 1894. He then discusses the applications of ozone; in some of these, however, other oxidizing agents are applicable, and ozone then comes in competition with these; he discusses the bleaching action of bleaching powder, sodium manganate and sodium bichromate, which are the three most commonly employed; with ozone, generally only one-third of the oxygen takes part in the reaction. In a table he gives in condensed form the figures for the output of ozone and the cost of 1 kg; the latter is 17.12 cents for the Yarnold, 19.98 for the Otto, 31.80 for the Andreoli system; the cost per kg of active oxygen is just three times this; the cost of electrical energy has been taken as 3 cents per electrical hp-hour. In another table he compares these figures with those for bleaching by other chemical methods, showing that bleaching powder is cheapest, then sodium bichromate, then ozone; wherever bleaching powder is satisfactory it is absurd to use ozone, and the latter will be restricted to those operations for which the two sodium salts or atmospheric air are the customary agents. With regard to cost, ozone occupies a fairly favorable position, while its ease of application and the non-production of solid or liquid by-products gives it a great advantage; there is every reason to expect, therefore, that the use of ozone in the manufacture of oils, fats and organic chemicals will rapidly extend. The advantages of ozone are not striking in cases where the oxygen of the atmospheric air is generally used, as the only advantage is a decrease in the time required; ozone may also prove to be too active, and its use in the maturing of wines and spirits, he thinks, is therefore less certain.

ALUMINUM ELECTRODES. Wilson. Lond. "Elec. Eng.," July 29.—The continuation (apparently the conclusion) of the reprint of his paper (see "Digest" last week). The description of the experiments with alternating currents is continued and the curves of the currents are given; Graetz's paper (described in the "Digest" some time ago) is briefly referred to, and the current curves in the circuit where a direct current is produced are given; these resemble a distorted alternating current curve, almost all of which lies above the zero axis. An important point in connection with these cells is the wearing away of the aluminum; thin plates become perforated with small holes; the evaporation of the electrolyte also needs consideration. He then describes experiments undertaken to find what effect this metal, with its film, has as a condenser, with varying frequency, temperature, and current; two plates were used in a saturated alum solution; he finds that such plates are suited for condensers. Other experiments were made with soda, ammonia and potash alums, and the results are given in a table; with a low frequency of 7.5 the results are not as good as with a high frequency of 92.4; non-saturated solutions show a better result with regard to efficiency at the higher frequency. His general conclusions are that the effect investigated in his paper takes time to develop and is not fully developed with alternating current frequencies of 16 and 98; it can be increased by increasing the current density for a given film, and it is greatly influenced by temperature; the metal with its film is suitable for condenser plates if due regard is given to current density and temperature; it might in some cases be found useful as an equivalent for a metallic resistance.

AMMONIUM AMALGAM. Pocklington. Lond. "Elec.," July 29.—If a strong solution of ammonium chloride is electrolyzed with a mercury cathode a pasty substance is produced, which is either ammonium amalgam or a mere froth of mercury with hydrogen and ammonium gases. He describes experiments undertaken to settle this question, and he did so by constructing a Daniell cell in which the zinc was replaced by this substance; the experiments and results are described and he comes to the conclusion that this material is at the moment of its formation a true amalgam of the radicle ammonium in its free state; but it rapidly dissociates into mercury, hydrogen and ammonia gases, which latter caused the mercury to froth.

ALUMINUM MANUFACTURE. Ristori. Lond. "Engineering" and "Elec. Eng.," July 29.—A reprint of a recent paper on its manufacture and properties, and a description of the rolling mills and foundry at Milton. The former journal publishes also the illustrations and the discussion. A reprint without the illustrations is begun in "El'ty," N. Y., August 10.

CALCIUM CARBIDE WORKS.—Lond. "Elec.," July 29.—A note from the London "Engineer." There are now twenty-two works in Europe and America, producing carbide in large and small quantities, and four others under construction; the production in America was 1925 tons in 1897, valued at $140,000; there are no figures available concerning the products from the European works. The output per electrical hp-day of twenty-four hours is reported to be 9.12 kg; most of that on the market contains about 80 per cent. of the carbide.

SULPHATING OF NEGATIVE ACCUMULATOR PLATES. Jumau. "L'Eclairage Elec.," July 23.—A discussion, with the results of numerous experiments, concerning the objectionable sulphating due to local action on the negative plates. This local action is shown by the evolution of hydrogen, and is due to two causes, the chemical action of spongy lead and sulphuric acid, and the electrochemical action of the couple formed by the lead and the alloy of the grid; the former action increases with the concentration of the acid, and is very rapid at a density above 1.45; the E. M. F. between the lead and the grid at a density of 1.27 varied from 0.49 to 0.54 volts, according as the grid is made of soft lead or antimony lead; the spongy lead is electropositive and the sulphating therefore means a loss of the charge of that plate. To determine the extent of this action he made some tests, the results of which are given; the plate was formed of pastilles originally obtained from chloride of lead, and these were analyzed after various periods of rest, and at two different densities of solution; the results are also given in curves; they show clearly the great effect of the density of the acid on this local action; also that densities not exceeding 1.32 can still be used, provided the cell does not remain inactive too long. Sometimes the sulphating is much greater and it is then due to particles of peroxide detached from the positive plate or to copper, antimony or iron, even though the antimony is only very slightly soluble in the acid; researches were made with antimony as the impurity and the results are given in tables and curves, showing its enormous influence in this local action for high densities of about 1.31; the action of iron is less energetic at first, but after longer periods of rest it becomes more active; the antimony is the material which is to be feared most; the tests showed that it is found mostly on or near the surface, 40 per cent. of it being in the outside layer of 0.1 mm; the E. M. F. of lead and antimony in sulphuric acid is about 0.5 volts, the lead being positive. His conclusions are that to avoid this local action the positive plate should be made of soft lead, as pure as possible; when the positive plates are made of a lead antimony grid the local actions are reduced by avoiding as much as possible the peroxidation of the antimony, and by using an electrolyte of low density; to put the negatives in the best condition they ought to be taken out often and have their outer layer rubbed off mechanically, notwithstanding the resulting slight reduction of the capacity.

PRIMARY BATTERY.—Lond. "Elec. Eng.," July 29; more briefly in Lond. "Elec. Rev.," July 29.—An article on the Row-

botham primary battery, which is being promoted by a syndicate in England; the former journal contains a brief report by S. P. Thompson and a longer one by Harrison; in both the editorial articles it is discussed somewhat unfavorably. The electrodes are carbon and iron, the former being in porous tubes through which a strong acid solution is circulated; the iron elements are placed between a series of these tubes and water is kept running through that portion containing the iron plates; there are, therefore, two circulating solutions; the acid is a mixture of sulphuric and nitric acid with water; the cells are mounted on an inclined plane, so the electrolyte passes in turn from one to the other; the gas given off from the cathode exerts a pressure in the air-tight compartment, forcing the solution to penetrate through the pores of the tube in about the same proportion as the energy is taken from the generator, and this is claimed to lower the internal resistance and maintain the voltage constant; the open circuit E. M. F. of a cell is said to be 1.35, and it appears that it remains constant at 1.05, while the battery is giving 100 amperes; Harrison's report contains a description of the cells and tests, according to which the total cost is below 10 cents per kw hour; it is shown editorially, however, that this is simply for the raw materials consumed; a corrected estimate made in the former journal gives the cost as more than three times this. The battery is intended to replace steam-driven dynamos. The former journal also contains an editorial article on this battery.

FULMEN ACCUMULATORS.—Lond. "Elec. Rev.," July 29.—A brief description of the results of Hospitalier's tests of these cells, the original of which was referred to in the "Digest" August 6 (under automobiles); see also June 18 and 25. (They were the cells which were used on the automobiles in the recent Paris tests.)

ELECTROMETALLURGICAL PROCESSES. Tommasi. "Elec. Eng.," August 11.—A description of his electrolytic process for the reduction, separation and refining of metals, which is claimed to be of universal application, and has the following advantages; no polarization, removal of the metal as soon as it is deposited, equal density of the liquid throughout, it being continuously in motion. The electrolyzer is described and illustrated; the application of the process to the desilverization of lead is described, with estimates of the cost. References to other descriptions of his process have already been given in the "Digest."

Units, Measurements and Instruments.

MEASURING THE POWER OF POLYPHASE CURRENTS. Blondel. "L'Ind. Elec.," July 25.—An interesting summary of the various methods suggested at different times by him, the general principles of which were described by him in his Chicago congress paper. The only instrument with which these measurements can be made is the two-coil wattmeter, such as his universal wattmeter, a brief illustrated description of which he gives; it has one movable coil and two fixed coils, one on each side; it is strongly dampened magnetically, and the two fixed coils are conveniently mounted, so that they may be connected in parallel, in series, differentially, or in separate circuits; in the methods described this instrument is used. The formulas concerning the polyphase currents are summarized briefly; the measurement of the total power is then described; it suffices to make two measurements by finding the power consumed in each of the two bridges, which are formed by the three wires, considering the one or the other as the common return; when the power in each circuit is to be measured separately the method depends on whether the star or the triangle system of connections is used; in the case of the former he uses an artificial neutral point by connecting the movable coil to all three through equal resistances. These three circuits being connected to a common point give a mean of the three voltages; the series coils are connected in the circuit to be measured; these connections are similarly made with each of the three circuits, in order to measure the power in each separately; if the centre connection of the system is accessible the artificial neutral point need not be used and the measurement becomes very simple; another method is the so-called fork method, in which the movable coil is connected with one end to the circuit to be measured and with the other to two equal resistances connected with the other two circuits; the movable coil is shunted by another having the same resistance in order to reduce the current to one-half; the power should be multiplied by two-thirds in that case, in order to give the correct reading; for the triangle arrangement the currents in the two conductors are made to pass in opposite directions through the two fixed coils, while the movable coil is connected between them. He then discusses the application to the measurement of power of the whole system; if it is desired only to know the total power it is simplest to use a double wattmeter formed of two ordinary wattmeters mounted on the same axis and giving directly the sum of the two readings; instead of this, two instruments may be used connected as described in one of the above methods; in a three-wire system, if it is desired to know the power on each circuit, it is necessary to have three wattmeters. Laboratory measurements are then discussed; when the circuits are not equally loaded the best method is to use a single apparatus, which is successively switched into each branch or bridge, depending on whether the star or triangle method is used; but there is great liability then to make an error in the connections; to simplify such measurements he describes a resistance box in which three-plug resistances are connected by the star system; also a multiple switch arrangement resembling somewhat a car controller, and having three sets of contact blocks, which are so arranged that the instrument may be switched onto any of the three circuits by the mere turning of a crank. The article is well illustrated with clear diagrams.

GRAPHICAL METHOD FOR MEASURING DIFFERENCE OF PHASE BETWEEN TWO SINE CURRENTS. Rossi. "Nuovo Cimento," December; abstracted in "L'Eclairage Elec.," July 30.—It appears to consist in the use of a polarized chronograph on which are recorded the oscillations, together with those from a tuning fork, the frequency of which is very nearly that of the current to be measured; he shows how the phase difference can then be determined.

MEASURING INSULATION RESISTANCE OF A THREE-WIRE SYSTEM.—Lond. "Elec. Eng.," July 29.—An answer to a request to deduce formulas, accompanied by graphical illustrations, for enabling the insulating resistance of the three respective wires to be determined by connecting each in turn to the earth through an ammeter.

DIFFERENTIAL TELEPHONE FOR MEASURING ELECTROLYTIC RESISTANCES. Federico. "Zeit. f. Elektrochemie," July 31; abstracted briefly from "Nuovo Cimento," 6, p. 161.—The vibrating diaphragm is placed between two opposite electromagnets, which can be adjusted by a micrometer screw; each one is in series with one of the two resistances to be compared; when they are equal there is no sound. The use of such a telephone is said to be surer and takes less time than when the ordinary telephone is used.

MIRROR FOR GALVANOMETERS.—"Elek. Zeit.," July 28.—A brief description of an improved form of mirror for galvanometers and like instruments with which a beam of light is used. To give a true picture of the source on a transparent scale a mirror, which is convex on one side and concave on the other, silvered on the former, is generally used; a cheaper mirror, and one which is more easily made, is one that is plain on one side and convex on the other, being silvered on the latter; if n is the index of refraction of the glass, then $2n$ times the focal distance is equal to the radius of curvature of the curved side. A short, analytical discussion is given, with some recommendations regarding scales.

DIRECT MEASUREMENT OF ELECTRICAL QUANTITY. Blondlot. "L'Ind. Elec.," July 25.—A reprint of the Academy paper noticed in the "Digest" August 6.

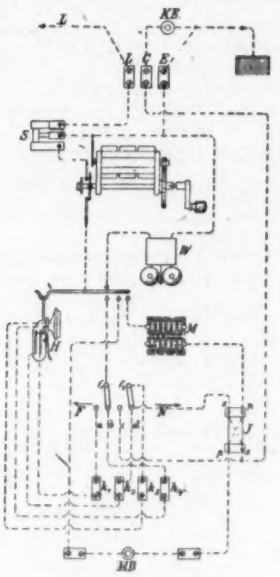
WATTHOUR METER. Lotz. "Elek. Anz.," July 31.—An illustrated description of his universal meter for continuous or alternating currents.

MEASURING APPARATUS. Armagnat. "L'Eclairage Elec.," July 23.—Brief, illustrated descriptions, taken from patent specifications.

CONDENSER FOR INDUCTION COILS. Tulbizuno. "L'Ind. Elec.," July 25.—An abstract, with the curves, of the article noticed in the "Digest" May 28 (where the author's name is Mizuno, which is probably correct.) See also "Digest," June 18.

Telegraphy, Telephony and Signals.

NEW CONNECTIONS FOR VERY LONG DISTANCE TELEPHONY. Schwensky. "Elek. Zeit.," July 28.—To increase the distance with present systems it is either necessary to use larger line wire, which is not always practicable, or to improve the microphones, in which direction improvement is not likely; he therefore endeavors to increase the distance by a change in the



connections; in the present paper he describes a system which was suggested in 1896, and has proved to be very successful. In this the receiver is used alone, without its microphone, and the transmitter is used without the telephone, the microphone of the receiver and the telephone of the transmitter being cut out of circuit when not in use; the necessary switching is accomplished by means of a small lever attached to the telephone, and which, in its natural

position, cuts out the induction coil, while when it is depressed it cuts out the telephone; this results in a very appreciable increase in the strength and clearance of the transmitted speech; this is due to the fact that in the usual method the current curves are flattened and shifted in phase by the apparatus, which is not really essential. The only objection to the system is that the persons talking cannot interrupt each other, but it is thought that they would soon get used to this. It has the further advantage that especially active microphones can be used, which formerly was not possible, as they affected the incoming waves too much. To make the system most effective these switch arrangements should be at both the receiver and the transmitter, but for distances below 1000 km (600 miles) the sound would be too loud, and the arrangements are therefore made that either the old or the new system can be used as desired. A method of accomplishing this, as also the complete connections, is shown in the diagram on page 189, which will explain itself; the small switches marked *f* are in the position shown in the figure for short distances, while they are moved to the left to connect with the wires *a* and *c* when the instrument is to be used for long distances. The lever *H* on the telephone then makes the connections for receiving or transmitting respectively as described above. A test was made with a metallic circuit of 3000 km (1800 miles) by connecting the longest 4 mm and 3 mm long-distance lines in the German circuits, and the results were surprisingly good; it was also tried over the cable from Berlin to Copenhagen, and gave very good results, far better than the usual arrangement.

DISTURBANCES IN TELEPHONES. Meyer. "Elek. Anz.," July 28.—A brief description of a method for preventing railway currents from producing disturbances in neighboring telephone wires. This is accomplished by merely connecting a condenser to the terminals of the armature of the motor on the car. Trials were made by a well-known company in Germany, and it was found that when the condenser was connected the sounds in the telephone suddenly ceased or were only very weak.

Miscellaneous.

THE HUMAN BODY.—"Elek. Anz.," July 31.—A note stating that according to a French Academy paper by Dubois the human body is a condenser with a liquid dielectric and a capacity of 0.105 microfarads.

ELECTRIC FURNACE. Gin and Leleux. Lond. "Elec. Rev.," July 29.—An abstract of a French Academy paper, noticed in the "Digest" March 19.

EXAMINATION QUESTIONS.—Lond. "Elec. Eng."—This journal publishes occasionally the examination questions of the City and Guilds of London Institute, for the department of magnetism and electricity; the issue of July 29 contains one set of these.

TURIN EXHIBITION. Montel. "Elek. Zeit.," July 28.—The beginning of a report on the electrical exhibits at this exhibition; brief descriptions are given, with some illustrations, the present portion being devoted to continuous current machinery.

PREVENTING COLLISIONS AT SEA. Herberts. "Elec. Eng.," August 4, and "El'ty," August 10.—An illustrated article in which he suggests the use of a thermopile on board ship for detecting the presence of an object such as a vessel, iceberg, etc., in case of a fog. Any object which has a higher or lower temperature than the surrounding atmosphere will radiate or absorb heat; he proposes to detect such heat radiations by mounting a horizontal thermopile on the two sides of a ship, revolving it slowly around a vertical axis and connecting it with a galvanometer which operates an alarm; it must be carefully protected from the heat radiations of the vessel itself and the sun; the object of revolving it is to give some idea of the direction of the approaching object; the strength of the current will give some idea of its distance; the successive alarms will show whether it is approaching or receding.

MICA.—"Elec. Rev.," August 10.—A short article on the mining and marketing of mica.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, third Friday of each month; J. R. Cravath, secretary.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, New York.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA., Pittsburg, Pa.—Meetings, third Tuesday of each month.

CANADIAN ELECTRICAL ASSOCIATION.—President, William H. Browne, Montreal; secretary, C. H. Mortimer, Toronto, Ont.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, William H. Wahl.

MASSACHUSETTS CHARITABLE MECHANIC ASSOCIATION, Boston, Mass.—Exhibition of Motor Carriages, October 10 to December 3, 1898.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, F. A. Copeland, La Crosse, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—F. W. Putnam, secretary, Salem, Mass. Next meeting, Boston, Mass., August 22-27, 1898.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York.—President, Dr. A. E. Kennelly; secretary, Ralph W. Pope. Meeting, third Wednesday of each month.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn; secretary, George F. Porter, New York. Next meeting, New York, May or June, 1899.

AMERICAN STREET RAILWAY ASSOCIATION.—President, A. E. Lang, Toledo, Ohio; secretary, T. C. Penington, Chicago, Ill. Next meeting, Boston, Mass., September 6, 7, 8 and 9, 1898.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.—President G. Tracy Rogers, Binghamton, N. Y. Next meeting, Hotel St. George, Brooklyn, N. Y., September 13 and 14, 1898.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—President, Samuel Insull, Chicago; secretary, Wilson S. Howell, Harrison, N. J. Next meeting, Sault Ste. Marie, Mich., September 12 and 13, 1898.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—Dr. C. R. Dickson, Toronto, Can., president; Dr. John Gerin, Auburn, N. Y., secretary. Next meeting, Buffalo, N. Y., September 13, 14 and 15, 1898.

THE OHIO ELECTRIC LIGHT ASSOCIATION.—President H. K. Wood, Piqua; vice-president, Emil C. Schmidt, Sandusky; secretary and treasurer, Samuel Scovil, Cleveland. Last meeting, Sandusky, Ohio, August 18 and 19, 1898.

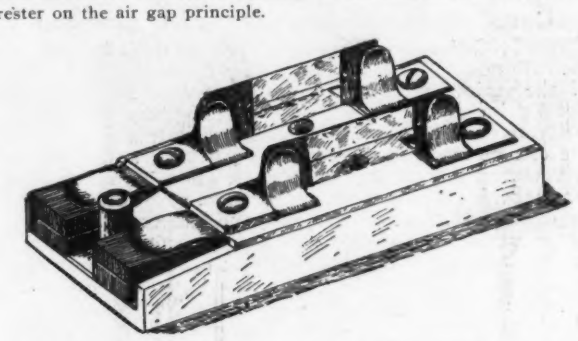
ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS AND MUNICIPAL ELECTRICIANS.—President, Will Y. Ellett, Elmira, N. Y. Last meeting Hotel Langewell, Elmira, N. Y., August 9 and 10, 1898.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—President, Judge James M. Thomas, Chillicothe, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind. Next meeting, June, 1899. Place to be named hereafter.

A New Combined Fuse Block and Lightning Arrester.

The telephone department of the Electric Appliance Company of Chicago has just put upon the market a combined fuse block and lightning arrester, intended to give absolute protection against burn-outs from crosses caused by trolley and electric light lines breaking and falling across the telephone wires.

The lightning arrester part of the instrument is constructed with two carbon blocks with perforated mica separating them. One block rests on the ground plate and the other is connected directly on the line, the idea being to produce an arrester on the air gap principle.



A Combined Fuse and Lightning Arrester.

The perforations in the mica separator produce this result when the carbon blocks are placed in their proper position on the arrester.

The effect of a lightning discharge across the carbon blocks is to produce a small amount of carbon dust, which can easily be removed by pulling out the carbon blocks, blowing out the dust and replacing them, when the arrester is in working order again.

The fuse end of the arrester should always be connected to the wires running to the instrument to be protected, and the carbon arrester end dirctly to the line wires.

The fuse portion of the arrester can be furnished with either the Postal or Western Union type terminals, an ordinary 2-inch copper or foil terminal fuse being used. The base is made of porcelain, and is 4¼ inches long by 1 and 1½ inches wide.

Improved Inclosed Arc Lamp.

The simplest means to accomplish an end is always the most satisfactory, This self-evident truth applies with particular force in mechanics, and its importance is fully appreciated by designers and constructors of electrical apparatus of all kinds. In arc lamp construction simplicity is one of the principal desiderata, and in late years considerable advance has been made in this direction. The inclosed arc lamp is one of the results of the effort to obtain the best results with the greatest economy.

Among the most recent designs of inclosed arcs may be mentioned those of the Sterling Arc Lamp Company, No. 214-222 West Twenty-sixth Street, New York City. This company is making direct current inclosed arc lamps for constant potential incandescent circuits of 110-120 volts; alternating inclosed arcs for single and multiphase circuits, 100-100 volts, and inclosed arcs for constant current series circuits. In all lamps the mechanism is practically alike, whether they are of the direct current or alternating types.

There are some noteworthy features in the Sterling lamp. For instance, the facility with which the inner globe can be cleaned and new carbons placed in position is an advantage possessed by this lamp that will be thoroughly appreciated by the practical lamp man. The inner globe is supported in a cup-like metal holder, fastened to the lower end of the frame rods, as shown in Fig. 1. This support also serves as the clamp for the lower carbon. The inner

globe is simply set in the holder and held in position by means of a cross bar and cap, sliding between the two frame rods and suitably held down upon the top of the inclosing globe, so that the latter is firmly and securely clamped in position, but can be easily removed by raising this cap bar. The upper sliding bar carbon holder is so constructed as to always maintain perfect alignment.

The regulating mechanism is of a new clutch chain feed type. One end of the chain is attached to the cross bar of the upper carbon holder. The chain passes over a toothed clutch pulley, and is kept taut by means of a small weight to the other end, and moving up and down in one of the hollow frame rods. The chain is not used for carrying the current, a separate conductor being provided for the purpose. The clutch pulley controls the movement of the feed chain and its attached upper carbon. The control magnet operates on a pivoted clutch, or brake bar, causing the chain pulley to be gripped by the clutch member, turned the necessary distance and carrying the carbon correspondingly. The clutch pulley is practically the complete regulating mechanism in all of the Sterling lamps, although its details are slightly modified to meet the conditions in each peculiar class of service. The actuating control magnets also vary in the different lamps, being single, series-connected solenoids in some, and double shunt and series differentially acting coils in others.

In the direct-current, constant potential lamp (Fig. 1) the clutch mechanism consists of a chain brake around the feed-chain pulley, and is attached to the operating bar, so that movement is imported to both ends of the chain when the bar is actuated. This clutch or brake chain operates as a hand brake, with both ends movable. The resistance is placed at the top of the lamp, and is held in place by radial arms, each arm carrying two porcelain insulators through which the resistance coils are carried in two concentric circles—once around and back. These lamps burn singly on 110-120 volt circuits, using about 4½ to 5 amperes at 80 volts.

The alternating lamp (Fig. 2) burns singly on 100-120 volt circuits at a frequency of 60 or 125 cycles, taking about 6 amperes at about 70 volts. It burns from 80 to 100 hours with one trimming. The regulating reactive coil, shown on the top, is so arranged that by changing the connections on the coil the lamp may be adjusted to any frequency and voltage. The clutch mechanism is the same as that used on the constant current series lamp. The regulating coils are double, series connected with the reactive coil, their double laminated iron cores being attached to the bar. This lamp is said to burn steadily and without noise.

The constant current series lamp (Fig. 3), as regards its mechanism, is substantially the same as the other lamps above described, the clutch wheel, however, being slightly modified. The freed chain wheel is clutched by a novel

FIG. 1.

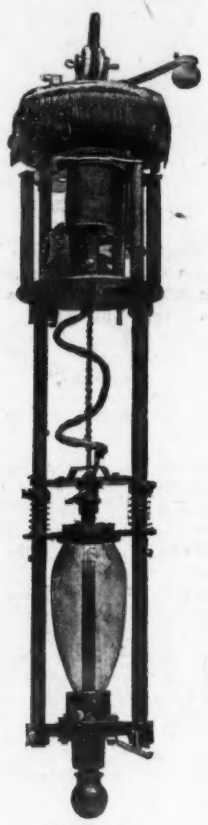


FIG. 2.

form of clutch device, which acts in a manner similar to the double acting chain brake above described. The regulating mechanism of the lamp is differential, the double series and shunt coils acting on solid cores connected to the clutch bar.

The lamp switch or line cut-out is a new feature. It is in a separate case, which is hung from the supporting hook, and permits complete disconnection of the lamp from the line. The line terminals from the switch to the lamps project through the bottom of the switch base in the form of two heavy insulated brass hooks. On the top of the lamp hood are two corresponding hooks. By engaging the two sets of hooks the lamp becomes connected with the line terminals. A centrally placed pin on the top of the lamp hood enters an aperture in a stud projecting downward from the switch box, and serves to hold the hooks firmly together and prevent any swinging of the lamp. The standard lamps of this type are made to take from 4 to 6 8-10 amperes of current at 65 to 70 volts.

The Sterling Company also makes inclosed arc lamps for power and railway circuits, 220 and 500 volts, and an open series arc lamp. The power and railway circuit lamps burn two in series on 220 volts and five in series on 500 volts, taking 4½ to 5 amperes.

All lamps are finished in plain black or in ornamental brass, Fig. 4, showing

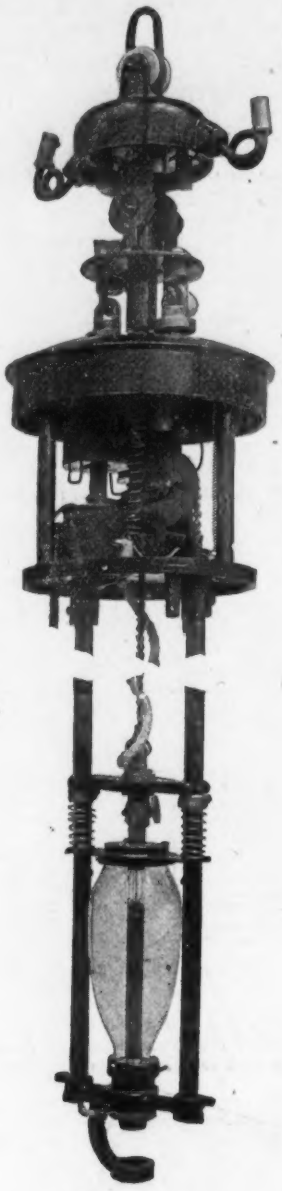


FIG. 3.

FIG. 4.

a plain, constant current, series lamp. The connecting hooks and the central steadying pin are clearly shown in this illustration.

The Measurement of Insulation Resistance.

There is no measurement of more importance to the present day electrical engineer than that of insulation resistance. Good insulation means the developed energy properly utilized; bad insulation means wasted energy, danger to life, fire risks, and a general uncertainty as to whether a plant is working well or ill.

It is not sufficient to make an occasional measurement of insulation or to depend upon the acceptance test indefinitely. Insulation should be regularly, continuously and systematically tested and proper records kept, since experience shows that from these records may be predicted the behavior of the insulation a week, two weeks, or a month ahead. Just as in a magazine a slow but continuous rise of temperature means danger and suggests taking steps to lower the temperature, so an insulation resistance of a cable, e. g., falling slowly day after day, means eventual breakdown and suggests proper provision being made long enough ahead to prevent accident or loss of light or power.

When the insulations are relatively low, say not over 4 or 5 megohms total, no method can be more simple or convenient than the use of a very sensitive milli-voltmeter. Such an instrument can be made sensitive enough to give one scale division with 100 volts through one megohm. The insulation may be read direct; its value will be, in each case, megs /N where N is the number of divisions of scale deflection. If a 500-volt power circuit is substituted for the 100-volt portable battery then the insulation is expressed by 5 megs /N.

Cable insulations run from 5000 to 20,000 megohms to the mile; perhaps 15,000 is a fair average. To measure such high values as these the voltmeter is valueless and we must use what is known as the "direct deflection" method. This method consists essentially in comparing the current produced by a known voltage acting through a known high resistance with the current produced by the same or other known voltage acting through the unknown insulation resistance.

If these currents be reduced to currents at the same voltage then the two resistances will be to one another inversely as the number of scale divisions deflection produced.

In practice either a Kelvin or a specially sensitive suspended coil (D'Arsonval) galvanometer is used in this method; deflections are observed either by the lamp and scale or telescope and scale method. For laboratory work the separate instruments, switches, etc., may be arranged upon the table.

Messrs. Willyoung & Co., Philadelphia, have arranged a very convenient portable set for the practice of this method and have been finding quite a demand for it of late among telephone and electric light companies. In laboratories it has also been found very useful, since all the necessary apparatus is compactly put up in permanent relation to itself and ready at all times for instant use.

Fig. 1 gives the typical plan of the set, while Fig. 2 is the detail of connections as actually run in the set. Referring to Fig. 1, C and B are the real main circuit terminals, A being simply a post from which is run a lead to the galvanometer short-circuit key. In series with the galvanometer is 100,000 ohms inductive resistance; this is used to "choke" the earth currents which would otherwise keep the galvanometer in continual motion. It also serves to make the effective galvanometer resistance R + 100,000, where R is the actual galvanometer resistance. This is of advantage in case of break in the galvanometer suspension, as the change in the galvanometer resistance caused by putting in a new suspension can be but inappreciable with respect to this large total, and hence the shunts are always right. Further, the heating of the galvanometer coil cannot affect the shunt ratios, since the change in the galvanometer (proper) resistance, even at 4-10 per cent. per degree C, is negligible when compared with the grand total (the 100,000 ohms inductive being of platinoid alloy, with, of course, small temperature coefficient). There are four shunts allowing, respectively, 1-10, 1-100, 1-1000 and 1-10,000 of the whole current to flow through the galvanometer.

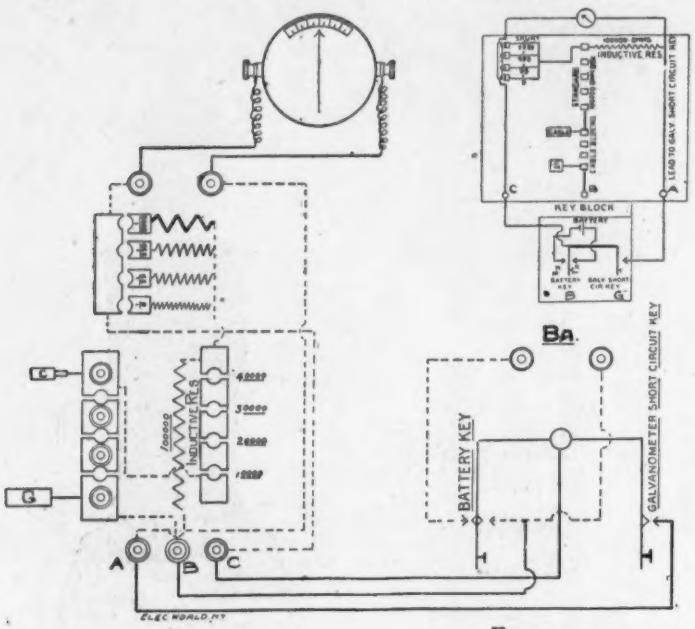


Fig. 1. Fig. 2.

In series with the galvanometer is the standard 100,000-ohm box, divided in four coils of 10,000, 20,000, 30,000, 40,000 ohms, respectively. Further on are the "cable blocks," to which the cable or unknown insulation is attached.

Fig. 3 shows the set ready for use. The galvanometer is a Rowland-D'Arsonval, mounted on gimbal bearings, and with telescope and scale attached. When not in use the galvanometer tips down flat against the telescope arm, which itself drops down into the bottom of the box. The standard 100,000 ohms, shunts and inductive resistance are contained in the interior box at the right. With 100 volts of battery ten scale divisions are obtainable through 5000 megohms of resistance.

The instrument as a whole folds up into a polished oak case, 22¾ inches by 10 inches by 7 inches deep, and weighing about 20 pounds. The entire time required to set up this instrument and have it ready for use with leveling, telescope adjustment and all effected is not over one minute.

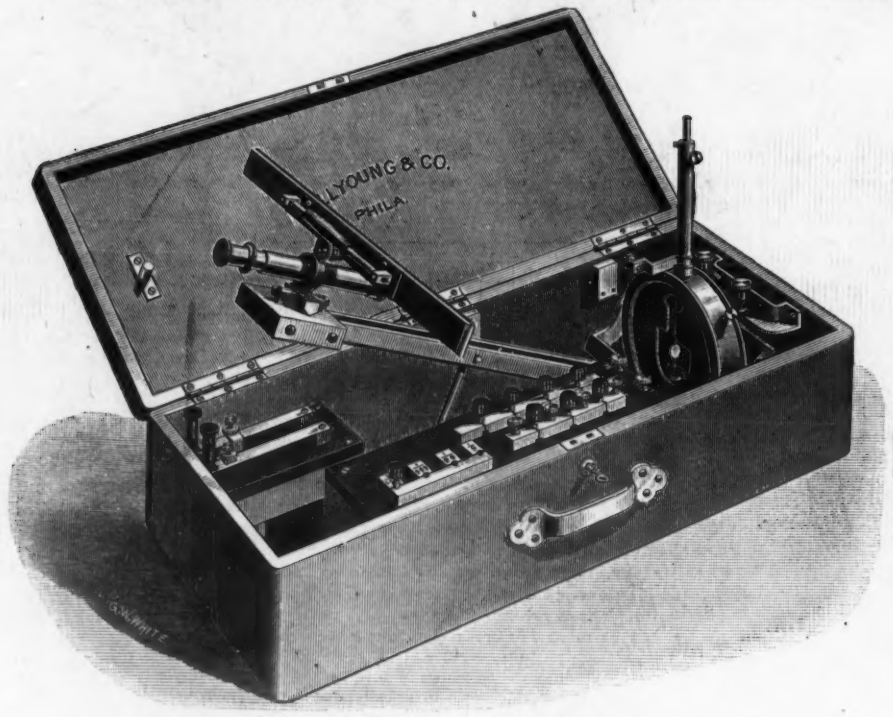


Fig. 3.

Direct Dynamos—II.

(*Concluded.*)

All Crocker-Wheeler multipolar frames are of similar type and one distinctive of this company. (See Fig. 3.) They show finely rounded lines, and are of girder construction. The yoke is a cast iron ring with short internal flanges on each side, which, besides strengthening the ring against breaking, afford considerable protection from mechanical injury to the field coils located between them. This yoke is divided into halves horizontally. Fig. 3 is a side elevation and section of a size 280 machine, and shows its construction clearly.

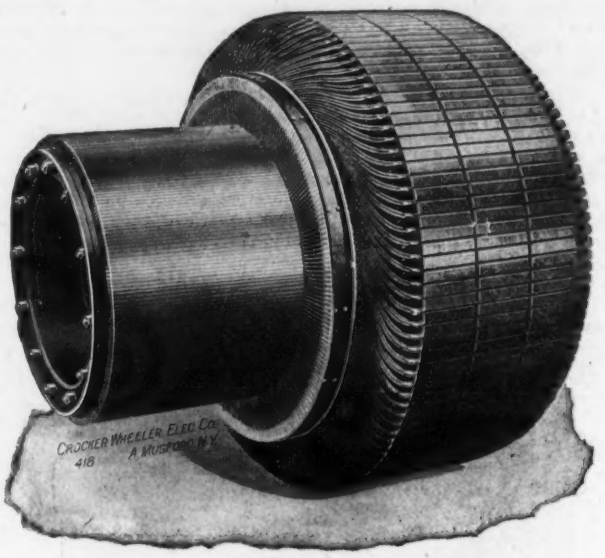


Fig. 4.

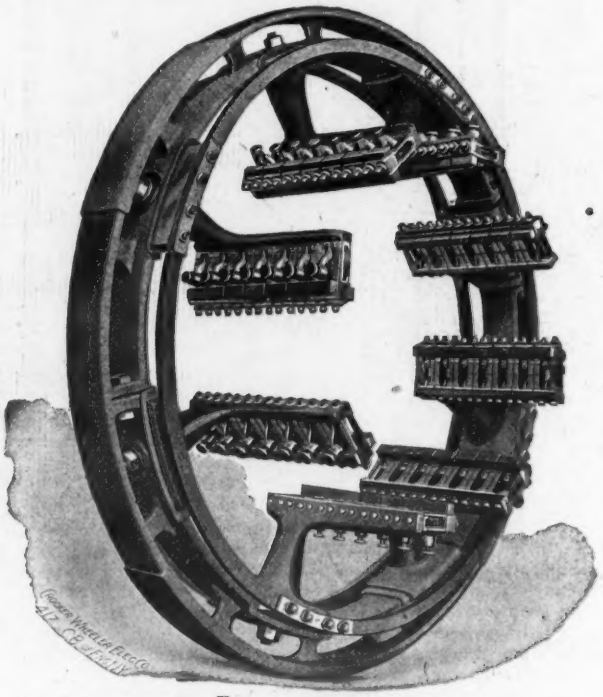


Fig. 5.

The poles are round and of cast steel, cast welded into the yoke, securing a perfect magnetic joint. They are provided with removable cast iron shoes clamped in place by screws after the field coils have been put on. These

shoes increase the surface of the poles exposed to the armature and therefore reduce the density of the magnetic flux where it enters the armature, and permit a long air gap or large clearance between armature and field to be used. A long air gap, in addition to its electrical advantages, obviates the necessity for an extremely accurate centring of the armature in the magnetic field, which would otherwise be of great importance and is difficult to secure. As the air gap is long, any slight inaccuracy in centring is but a small percentage of the total length and therefore has but a small effect on the magnetic balance of the machine. A dynamo with short air gap, whose armature is out of centre, will have its efficiency and capacity greatly reduced by the flow of current inside the armature from one portion of the winding to another. Its shaft will also be subjected to a magnetic pull at right angles to its axis, which will tend to make the bearings heat, heavily loaded as they already are with the weight of the armature and fly wheel.

Each pole is excited by a separate field coil, because this method gives greater economy of field current and copper than any other form. The pole pieces are made round, because they are more efficient than those that are square, rectangular, or of any other shape, since they require less copper and need less current to energize them. The pole pieces do not need to be laminated, because they have been designed with such a relation of length of air gap to width of slot opening that eddy currents are almost entirely avoided. Pole pieces, when laminated, must be made rectangular in shape, and they then lose much of their advantage of freedom from eddy currents, owing to their inefficient form.

All Crocker-Wheeler dynamo armatures have toothed cores. The slots have parallel sides with rounded bottom and very narrow opening at the top, which compels the winding to be threaded through from the ends. The cores

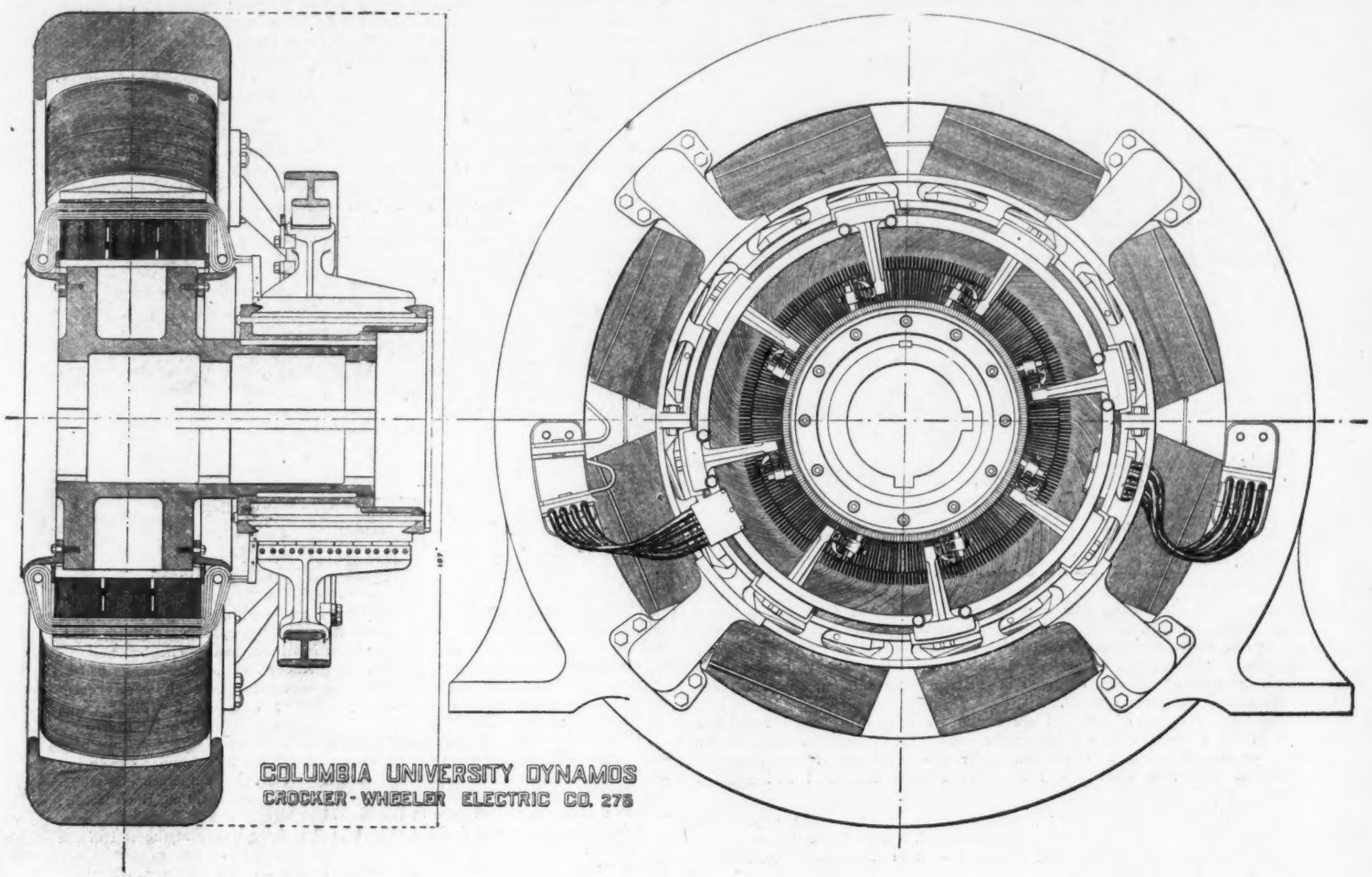


FIG. 3.

are built up of sheet iron punchings .022 of an inch in thickness, except the end discs and those on each side of the air spaces, which are three-sixty-fourths of an inch thick. Owing to the large diameter of the armatures, the discs cannot be made in complete circles. They are punched out in sections and put together with joints staggered. At one or more points in the core ventilating ducts one-half of an inch wide are formed by the omission of a sufficient number of discs and the insertion of distance pieces, which allow free circulation of air. The laminæ are insulated from each other by a layer of oxide formed during the annealing process and in addition by a sheet of paper after every fourth disc.

The cores are mounted on cast iron spiders, as shown in Fig. 3, which are keyed to the engine shaft. The spider carries a sleeve extension at one end for the support of the commutator. The armature and commutator are therefore a unit, and may be removed from the shaft without disturbance of the connections between them.

The armatures, as in all large multipolar machines, have drum windings and these are usually connected for multiple circuits, though occasionally, in special cases, they are connected for two circuits. The conductors consist of solid copper wires of large size, triple cotton covered, and shellacked. This covering serves to insulate the wires from one another, but is not relied upon to insulate them from the core. In the slots are placed tubes, one above the other, made of micanite cloth and pressboard rolled up on a form and glued together. These tubes insulate the wires in the slots from the core. The conductors are threaded through the tubes from the ends, as can be seen in Fig. 3.

This "cable" winding is an improvement over the bar windings originally used and patented by us and now used by other makers, since it has no joints except at the commutator tails. It has the advantages over bar windings of being free from joints and of employing standard wire or copper rod, which is always readily obtainable, whereas the special conducting bars for bar windings require riveting together and can only be obtained from the makers of the machine. This is a point of great importance should a breakdown occur at a place remote from the manufacturer.

The commutator, the most costly part of an armature, has received the closest and most careful study in its design. The bars are made of the best hard drawn copper, with copper tails, riveted as well as sweated into one end. These tails are made sufficiently long to keep the soldered joints with the armature conductors cool, even though the commutator bars should become overheated from any cause, and are arranged so as to permit free circulation of air between them.

The larger sizes of commutators have their bars held down by sectional collars, each section of which covers but four or five bars. The object of this is to make it possible to bring equal pressure to bear on all the bars by individual adjustment of the parts of the collars, which are drawn toward the centre by wedges operated by screws at the ends of the commutator. It is obvious that repairs are facilitated, since one or more bars can be taken out without disturbing the others by removing the sections of the collars which hold their ends.

The spider which supports the commutator on the sleeve extension of the armature spider has wide spaces between its spokes, permitting the air to pass freely through the armature from end to end.

The commutator surfaces are ample, and are designed with reference to the energy dissipated in the act of commutation and to the heat caused by the mechanical friction of the brushes. A finished armature, ready for mounting on engine shaft, is well shown in Fig. 4.

The form of brush rigging adopted is shown in Figs. 5 and 8. A circular iron casting made in two parts is supported by brackets fastened to the yoke of the machine (see Fig. 3), and is, therefore, independent of the outboard bearing. To this ring, but insulated from it, are fastened the various sets of brushholders by means of cast iron brackets seen in Fig. 5. The brushholders are of what is called the parallel movement type, the brush being

clamped firmly in a brass box which moves radially to and from the commutator. The brush is therefore always perpendicular to the surface of the commutator. No spring or sliding contact carries any current. An illustrated description of this holder may be found in The Electrical World of July 23, pages 89 and 90. All "positive" sets of brushes are connected together by a flat copper conducting ring mounted on one side of the "rocker ring," and all the "negative" brushes are connected by a similar ring on the other side. The exposed portions of these copper rings are insulated by a wrapping of cord covered with insulating paint. The brushes are shifted simultaneously by rotating the rocker ring by means of a screw operated by a hand wheel. When so desired, a special brush lifter can be added for lifting all the brushes from the commutator at the same moment by throwing a lever.

The standard brushes are of carbon, though in special cases they are fibre graphite and carbon in which are imbedded layers of copper gauze. The brush areas have been arranged with reference to the conditions of commutation—namely, the self-induction of the armature coils, the speeds of the machines, and the carrying capacity of the carbon. The cross section per ampere, therefore, varies somewhat with the different machines; it does not exceed, however, 40 amperes per square inch for standard carbon brushes, and averages about 30 amperes per square inch. For carbon gauze brushes it is twice as much and for graphite maybe half as much.

It is recommended in all cases where the armature is mounted upon its shaft by being slipped upon it as a sleeve, that the shaft be sent to the works to insure that the forcing on is done in the best possible manner, except for sizes of machines which have split hubs. If this mounting is done at the place of installation it is less convenient on account of the absence of proper tools and handling machinery, and risk of damaging either the shaft or the windings of armature is incurred. The fit between an armature and its shaft must be so exact that a discrepancy of a thousandth of an inch is enough

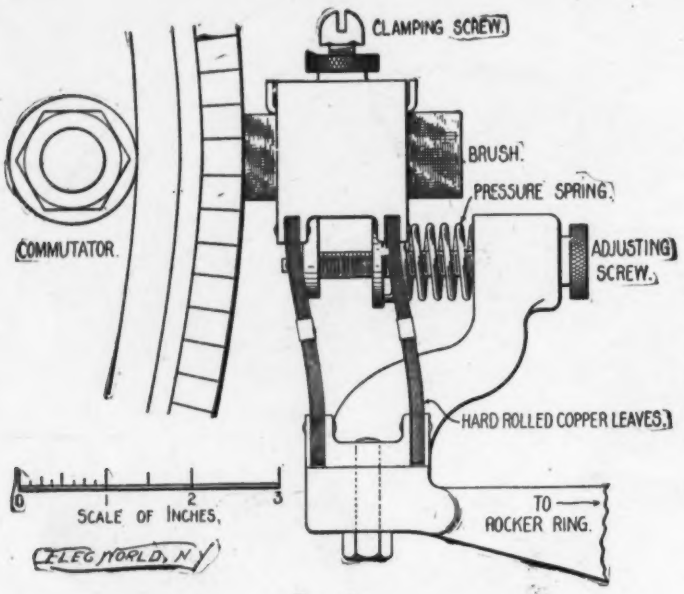


Fig. 8.

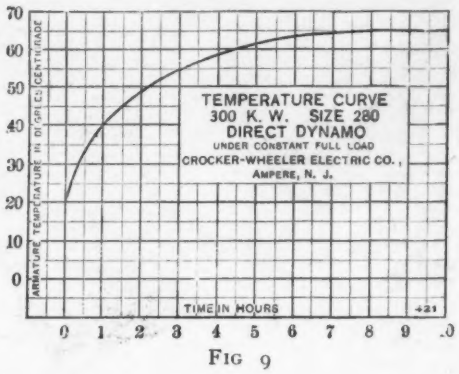

TEMPERATURE CURVE
300 K. W. SIZE 280
DIRECT DYNAMO
UNDER CONSTANT FULL LOAD
CROCKER-WHEELER ELECTRIC CO.,
AMPERE, N. J.
ARMATURE TEMPERATURE IN DEGREES CENTIGRADE
TIME IN HOURS
+21
0 10 20 30 40 50 60 70
0 1 2 3 4 5 6 7 8 9 10

Fig 9

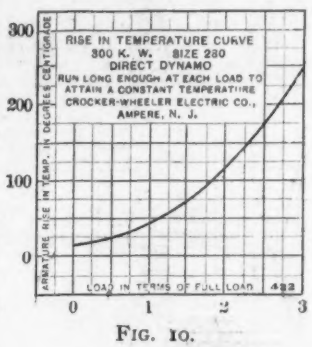

RISE IN TEMPERATURE CURVE
300 K. W. SIZE 280
DIRECT DYNAMO
RUN LONG ENOUGH AT EACH LOAD TO ATTAIN A CONSTANT TEMPERATURE
CROCKER-WHEELER ELECTRIC CO.,
AMPERE, N. J.
ARMATURE RISE IN TEMP. IN DEGREES CENTIGRADE
LOAD IN TERMS OF FULL LOAD
482
0 100 200 300
0 1 2 3

Fig. 10.

to cause it to stick when half way on, and entails great delay and possible damage before it can be removed and have its bore scraped to a fit. In the factory the whole resources of a machine shop are available for these delicate operations, and they can be performed with greater success and dispatch than in the disordered and crowded cellar of a large office building or other place where a plant is being installed.

The Crocker-Wheeler machines are tested for proper insulation resistance and dielectric strength before leaving the works. The insulation standard for all sizes and all voltages of 500 and under is a resistance of one megohm, measured with field circuits and armature circuits connected and brushes down.

This resistance is 100 times as great as need be to prevent appreciable leakage of current, but the value is placed at such a high figure because, with the excellent quality of insulating materials used in these machines, it is as easy to obtain as a lower one.

It frequently happens that our insulation falls below this figure, but this is in nowise due to poor materials, but generally to the weather, which, when humid, very greatly reduces insulation resistances by permitting leakage over the surface of insulators.

The remedy for such difficulties is to run the machine until it warms up, when the moisture will be driven off and the insulation resistance be restored.

The standard test for dielectric strength is the application of a stress twenty-five times as great as the normal working stress, by the use of a voltage five times as great as the circuit pressure.

This test is of much greater importance than that for insulation resistance, since ability to resist puncture is of vital importance to the machine's operation, whereas the infinitesimal leakage resulting from a low insulation resistance is of no consequence whatever. Many engineers consider the insulation resistance a measure of the dielectric strength; but this is wrong. Many substances, whose insulating properties are high, are weak dielectrics. For instance, dry air has an infinite insulation resistance, but is excelled in dielectric strength by common, hard fibre, whose insulation resistance is comparatively low.

On all sizes of direct machines a quarter of an inch is allowed between the bottom of the feet and the top of the base upon which they rest to receive other insulating or metallic adjusting pads.

Electrical insulation of the frame undoubtedly safeguards the insulation between the frame and the windings, but in well-constructed machines this latter exceeds in so great a degree the maximum strain ever put upon it, that further protection is unnecessary. This is especially true in view of the fact that the armature, which is the most delicate element of the machine, and the one which, on account of its rapid motion, is most likely to suffer a deterioration of its insulation from the collection of dust, the accidental striking of foreign objects, and from other causes, cannot be insulated from the ground owing to the rigid manner in which it is necessary to attach it to the prime mover. Even when insulation is inserted between the frame and the base erection it quickly becomes dirty, and largely loses its insulating properties.

A partially insulated frame strains the insulation of the windings as much as a wholly grounded one, and has serious disadvantages, as the fact that, should any of the connections of the electrical circuits accidentally come in contact with the frame, the regular ground detector test for faults would not discover it, and trouble would be latent, awaiting an accidental connection between the frame and the ground to bring it out; also, all insulating materials are liable to shrink, and on this account are bad for mechanical uses. A shrinking of the insulation pad will not only permit the bore of the fields to settle eccentric to the armature, but will so relieve the tension of the holding down bolts as to render it possible for the machine to slide sidewise if there is sufficient jar to start it.

For the above reasons metallic adjustment pads are recommended with these machines, except where otherwise specified, since their use is now permitted by the underwriters' regulations of all but a few places.

The frame is lifted from the base by set screws, and when the proper distance is determined the pads are put in, the adjustment made by thin sheets of iron, the screws relieved, and the holding down bolts tightened.

Where insulation is demanded use the hardest kind of fibre to encounter as little shrinkage as possible, and make the adjustment in the same manner.

The Crocker-Wheeler Electric Company has adopted as its standard increase of temperature 45° C. over the temperature of the surrounding atmosphere, and, while this is 5° higher than is used by many builders of to-day, it is absolutely within the limits of safety after deducting an extremely large margin. While we believe in the standard of 45° C., we can meet a limit of 40° by slight modifications in windings, and many of our machines come within this lower limit normally. It is well known that a temperature of 100° C., corresponding to the boiling point of water, is absolutely safe for insulation; in fact, the limit is considerably higher than this.

As regards sparking, Crocker-Wheeler dynamos are built with special attention to perfect performance at the brushes. There is no sparking from no load to full load and no shifting of the brushes, and with very slight shifting there will be no sparking from no load to 25 per cent. overload. The brushes can be set for no sparking from ¼ load to 125 per cent. of load. An overload of 25 per cent. for one hour will not cause a rise of temperature of the core exceeding 55° C. A momentary overload of 50 per cent. can be carried without undue sparking or heating.

In Fig. 9 is shown the rate at which the temperature of the armature core of a large dynamo rises when the machine runs for ten hours under steady full load. The temperature of the air in this case, which is the temperature at which the dynamo starts, is taken as 20° C. It will be noticed that the machine attains a constant temperature at the end of about the eighth hour of its run, and that it is within two degrees of its constant temperature at the end of the sixth hour.

The temperatures which the armature core of a direct dynamo will attain if run sufficiently long at each load to reach a constant temperature, are graphically shown in Fig. 10. A range of load from 0 to 300 per cent. of full load is given.

At about 250° C. the cotton insulation of the armature wires will begin to char, hence a 300-per cent. overload, if long continued, will burn out the machine. Greater percentages of overload can be withstood, if they are for shorter periods of time. In these curves the heat generated in the armature by the current and the hysteresis and foucault current losses is divided by the specific heat of the mass of iron, with proper allowance for dissipation by convection and conduction.

Though designed as dynamos, these machines operate perfectly as slow-speed motors, and are often used when large slow machines are required. The shunt winding is employed most frequently for motors because it gives practically constant speed at all loads. The compound winding is used on motors which have to do "lumpy" work, the series coils serving to strengthen the field at moments of greatest load, thus preventing sparking which might otherwise result, and reducing the momentary excessive draft of current from the mains. They have the disadvantage of not being so constant in speed as the shunt motors. Owing to the drop in voltage in the series coil and to the stronger field employed, a given armature will run about 5 per cent. more slowly in a compound field than in a plain shunt field.

NEWS OF THE WEEK

Financial Intelligence.

THE METROPOLITAN STREET RAILWAY COMPANY, of New York City.—At a meeting of the stockholders held last week the proposed increase in the capital stock from $30,000,000 to $45,000,000 was unanimously ratified. It is stated that $10,000,000 of the additional stock will be used to liquidate outstanding obligations, the rest to be held in the treasury as a fund for improving the property.

GENERAL ELECTRIC.—A special meeting of the stockholders of the General Electric Company was held at Schenectady on August 10, for the purpose of considering the proposition to reduce the capital from $31,000,000 to about $21,000,000. The question of injunction, it is stated, was brought up, and Chairman Coffin read an opinion of counsel to the effect that Mr. Livermore's bill of complaint now pending would not cause any restraint to issue. Should its plea be granted the stockholders would return to original ratings. An adjournment was taken until Wednesday, August 17, when it is thought a decision will be reached.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, August 15, 1898.

MR. WILLIAM MAVER, JR., will shortly bring out a book entitled "Electrical Underground Conduits and Cables." Mr. Maver has been actively connected with underground work since its inception in this country, and is a recognized authority on this subject. His forthcoming book, therefore, will likely meet with a good demand, and will fill a want which at present exists in the literature of this art.

THE METROPOLITAN STREET RAILWAY COMPANY of this city has obtained permission from the State Railroad Commission to increase its capital stock from $30,000,000 to $45,000,000. The State board on August 11 granted the Metropolitan Company eighteen applications for permission to change the motive power on the Broadway, Lexington and Columbus Avenues roads, which are now operated by cable power. The underground conduit system will be introduced on these lines. President Vreeland states that on the completion of the work of introducing the underground conduit system on the Sixth and Eighth Avenues roads, the Broadway and Columbus Avenue lines will receive attention. According to a statement by Mr. Vreeland it is the purpose of the company, after all of the improvements on its lines have been completed, to run a large number of cars quickly and directly into the business section from every point up town. The cars from Second, Lexington, Madison, Sixth, Eighth, Columbus and Amsterdam Avenues will all turn into Broadway at convenient points. At certain hours a large proportion of the cars on the uptown lines will be run direct to the shopping district. Cars from Amsterdam, Columbus, Eighth, Madison and Lexington Avenues will be run through Fifty-ninth Street down Sixth Avenue and back again. During the evening, when people want to go to the theatres, all of the uptown lines will converge into Broadway. By the time the company gets its system in good working order it will have expended fully $15,000,000 for improvements. Among the roads to be equipped with the underground trolley system are the Twenty-eighth and Twenty-ninth Street cross-town lines, the Thirty-fourth Street cross-town, the Metropolitan cross-town, the Centre cross-town, the Chambers, the Bleecker Street and Fulton Ferry, Forty-second and Grand Street ferry, Fulton Street, Ninth Avenue, Broadway and Seventh Avenue lines, the Belt line, the Avenue C line and the remaining parts of the Second, Sixth and Eighth Avenue lines, all of which are operated by the Metropolitan Company.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., August 13, 1898.

IT IS NOW EXPECTED that the new lighting station in Buffalo will be ready for operation by October 1. Engineer Stott, of the company, is in Schenectady assisting in getting the large amount of new apparatus in readiness.

IT IS ANNOUNCED that the new Lockport trolley line will be in operation next Monday, and as a car has already been run over the line the road is a fact now. It is nearly 30 miles long. The cars are built with motors capable of developing a speed of a mile a minute.

THE NIAGARA FALLS COMPANY is preparing to extend its operations to Depew, the new manufacturing centre, 10 miles east of Buffalo, at an early date, and is already at work obtaining right of way. One would suppose that the line of the Depew Terminal Railway would be taken, but the road objects, for the reason that a line carrying a current of such high voltage would interfere with the telegraph wires on the line of the road. It is expected that a line will be taken adjoining the lands of the road and left without fencing, though some of the authorities believe that at least the poles should be fenced, to prevent intrusion and possible accident. Depew will take about 20,000 horse-power eventually, without doubt, though it is not understood that actual contracts have yet been made.

APPLICATION has been made to the Niagara Power Company for power from the tunnel with which to operate the Buffalo Valley trolley line as soon as it is ready, which, however, will not be this year. This road would take its current from the Depew line instead of from Buffalo, since it is no further to Depew than it is to Buffalo, and a transformer station could be established at Elma, which is about a third of the distance from the Buffalo end of the Buffalo Valley road. Then by establishing a second station at Wales, about two-thirds of the distance out, the entire road could be operated. The terminus of the road at Java is 27 miles from Buffalo and something like 45 miles from the tunnel, but distance is now a mere matter of cost of the transmission line, the experiments made in Buffalo fully demonstrating this. It is also the intention of running the Buffalo & Depew trolley line with Niagara power when it is built, so that with the new Lockport trolley line already a fact and the systems of Buffalo, Niagara Falls, the Gorge road, the Victoria Park road across from the falls, and doubtless with all the roads inside and running into Tonawanda soon in the same combination, so far as the derivation of motive power is concerned, there is already a vast amount of work already done or soon to be done by the Niagara Company. Besides it must be understood that but a small part of the power actually needed, and which will soon be obtained from the same source, has yet been arranged for or asked for. Buffalo is expected to take 30,000 horse-power in the near future.

ST. LOUIS NOTES.

ST. LOUIS, Mo., August 13, 1898.

THE STRIKE among the linemen is still on, and the men claim that it will last. Neither side seems inclined to give in.

AN INJUNCTION has been granted to prevent the St. Louis, Belleville & Suburban Electric Railway Company from laying its rails on the Belleville turnpike.

THE ST. LOUIS, BELLEVILLE & SUBURBAN ELECTRIC RAILWAY COMPANY has filed its acceptance of the franchise granted it by the Belleville City Council to operate its cars over the portions of the tracks of the Belleville City Electric Railway.

NEW CARS.—A half a dozen representatives of street car manufacturers are registered at the various hotels. They are here to bid on 75 to 100 new cars for the Scullin Street railway system. The contracts will be placed in a few days, and the new cars will represent an outlay of not less than $200,000.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., August 7, 1898.

THE TELEPHONE LINE BETWEEN HEPPNER AND BURNS, Ore., has been completed, and is now in operation. The latter place now enjoys telephonic communication with Canyon City via the new line.

THE STOCKTON GAS & ELECTRIC COMPANY has its new gas well down over 700 feet, and on its completion this winter will bore others, until it obtains a sufficient output of gas to supply all the fuel needed at its works. The company now has six wells in use.

THE TACOMA CITY COUNCIL recently rejected the offer made by C. B. Hurley in settlement of the litigation pending against the Tacoma Light & Water Company, growing out of the sale of the electric lighting plant to the city. The offer consisted of $100,000 and payment of the attorneys' fees in the case.

THE FIRE ALARM WIRES OF LOS ANGELES are being placed in the underground conduits of the Sunset Telephone & Telegraph Company, which company offered the city the free use of its ducts. City Electrician Francis, who superintends the work, will have the overhead wires removed as soon as the underground system is completed.

THE WHITE PASS & YUKON RAILROAD COMPANY, which recently completed a section of the first railroad in Alaska, has its terminus at Skaguay. The company recently placed contracts for 135 miles of telegraph wire and the supplies needed for equipping its offices at stations along the road. A telephone system will also be installed for the use of the company.

MR. W. H. HAMMOND has returned from England, where he obtained capital for the development of a water power electric proposition in Tuolumne County, Cal. He is associated with A. G. Wishon in a company which intends to install a plant on the Kaweah River, 29 miles east of Visalia. The transmission line is to be extended to Porterville, Tulare and Lindsay, if a sufficient amount of power be contracted for by residents of those towns. At Porterville the rate demanded is $50 per horse-power per year.

THE CITY ELECTRIC LIGHTING AND WATER WORKS PLANT for the town of Healdsburg, Sonoma County, Cal., has been laid out by engineers Barnes and Dodge, and representatives of electrical manufacturing companies are now figuring on the specifications. Two hundred horse-power will be transmitted 8 miles at 10,000 volts from a water power electric station to a sub-station in the town, where the voltage will be lowered to 2200 volts for distribution. Alternating arc lamps will be used for street lighting. The working head of water is about 1020 feet. A triplex pump is to be driven by an induction motor.

THE CONTRACT FOR LIGHTING THE STREETS of San Francisco for a term of two years from August 1, 1898, by the San Francisco Gas & Electric Company, has been stopped by the veto of Mayor James D. Phelan on the resolution of the Board of Supervisors. One of his reasons for taking such action is said to be that there is a case pending which might affect the validity of the contract if awarded. The Mutual Electric Light Company some time ago brought suit to restrain the Supervisors from letting the contract until they had accorded the Mutual Company equal privileges with the other company in regard to the erection of poles and overhead wires where necessary.

THE ALASKA TELEGRAPH & TELEPHONE COMPANY, which was incorporated under the laws of California in July, 1897, by San Francisco capitalists, has, after overcoming much opposition, secured a franchise. The Canadian Government grants the company the right to construct and operate telegraph and telephone lines in Canadian territory over the Chilkoot Pass, running along the lakes and up the Lewis and the Yukon Rivers to Dawson City. The line will start from Juneau and extend to Dyea, thence in a northeasterly direction over the Chilkoot Pass. After following the line of the rivers to Dawson, it will be continued as far as Circle City, which will be the terminus. The total length of the line and branches is estimated at 1000 miles. Construction will be commenced very soon, and the line rapidly pushed to completion. The Canadian Government is to have free use of the line. Theodore Reichert, formerly Surveyor General of California, is president, and J. F. Fassett secretary.

Milwaukee Notes.

Milwaukee, Wis., August 11 1898.

A LOCAL TELEPHONE COMPANY is being organized at New Richmond by Dr. Eply.

THE WISCONSIN TELEPHONE COMPANY will replace the system now in use at Washburn by the Guard system.

A BELOIT COMPANY has submitted a proposition to the city of Boscobel to erect an electric lighting and water system to cost $35,000.

THE MILWAUKEE, RACINE & KENOSHA ELECTRIC RAILWAY COMPANY is again asking Kenosha for a street railway franchise.

CONTRACTS for the construction of the Milwaukee Electric Railway & Light Company's power house at Oneida and Rivers Streets have been let.

THE CENTRAL OPERATING & CONSTRUCTION COMPANY of Fond du Lac has been incorporated with a capital stock of $25,000. The company will operate passenger and freight boats on Lake Winnebago, and will build or occupy a system of water works, electric lighting plant, gas lighting plant and street railway in the city of Fond du Lac. C. S. Smith, Menzo Smith and Maurice McKenna are the incorporators.

New England Notes.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Build'ng, 620 Atlantic Ave.,
Boston, Mass., August 12, 1898.

A SMALL FIRE was started in the station of the Boston Electric Light Company on the night of August 9, causing the suspension of the lighting service in the business part of the city. The damage was slight, but the inconvenience was great. The service was resumed after a few hours' delay.

MR. C. O. BAKER, manager of the Chicago office of the Anchor Electric Company, Boston, has made a trip to Boston for business and pleasure. He picked up some orders for Anchor goods in the towns through which he passed, and he found the Anchor Company business very active in the sections visited on his eastward journey.

THE ANNUAL REPORT of the Wire Department of Boston for the year 1897, just issued, is a very creditable piece of work. Mr. Thomas W. Flood, Commissioner of Wires, makes a most exhaustive report of the work of his department, and shows what has been done in the way of removing overhead wires in his bailiwick and placing them underground. A summary of the work during 1897 shows these results: Subway built, 154,580 feet; length of duct, 742,392 feet; service connections, 1099; manholes built, 782; cable drawn in, 853,794 feet. The main conduits laid during the year consist of cement-lined, vitrified clay, wrought iron and wooden ducts. Many very excellent half-tone illustrations give views at different points in the city showing the appearance of the streets before and after the removal of wires. The most interesting illustrations are those showing the disastrous effects of the blizzard of last February upon the overhead lines in the city streets. They give an excellent idea of the damage wrought by that memorable storm, and furnish a strong argument in favor of placing all wires underground.

Canadian Notes.

Ottawa, Ont, August 13, 1898.

THE BOARD OF GOVERNORS of McGill University, Montreal, have appointed Prof. R. B. Owens, of the University of Nebraska, to the chair of electrical engineering at McGill.

THE IMPERIAL PRIVY COUNCIL has refused to grant the Toronto Street Railway Company leave to appeal from the decision of the Ontario Appeal Court, which upheld the right of Toronto to assess rails, poles, etc.

ANOTHER APPLICATION will be made at the next session of the Dominion Parliament for a charter for a bridge between the city of Hull and Ottawa to give the Hull & Aylmer Electric Railway entrance to Ottawa. A vigorous lobby defeated the bill at the last session of Parliament.

THE JACQUES CARTIER WATER POWER COMPANY, of Quebec, has been organized with the authorized capital stock of half a million dollars. The company has acquired from the Standard Light & Power Company, of Montreal, its chartered rights to introduce electricity for light, power and heating throughout the city of Quebec. It is expected that the company will have the work in full operation on or before January 1 next.

THE MONTREAL PARK & ISLAND RAILWAY COMPANY has been refused the right to appeal to the Privy Council from the judgment of the Court of Appeal for the Province of Quebec. The company entered into a contract with the town of St. Louis du Mile End some years ago, by which it was to supply the town with a first-class electric car service on the principal streets, with transfers to the Montreal Street Railway. The company failed to carry out its contract, and the corporation took out an action against it and prevailed.

THE OTTAWA CITY COUNCIL has passed the Metropolitan Electric Company's by-law which lets in a new electric corporation to operate in Ottawa. The by-law provides among other things that the company is not to charge for incandescent lighting more than 1 cent per ampere hour, with a discount of 40 per cent. and a further discount of 12 per cent. for cash with fifteen days, off the lowest meter price. At the expiration of ten years the city has a right to acquire the property of the company at its actual cash value. The company has made arrangements for obtaining its water power at the Chaudiere Falls, and has already secured over 2000 horse-power to begin with and an option for 5000 more if needed.

Mexican Notes.

Monterey, Mexico, August 8, 1898.

A NEW TELEPHONE LINE has been established between the office of the Governor of the Federal District and Cuajimolpa.

THE CONTRACT has been let for the lighting of the new theatre on Zaragoza Street, city of Mexico. There will be a total of 450 incandescent electric lights.

SENOR E. DYSTERUD, superintendent of the Monterey electric light plant, has returned from a business visit to New York and other Northern and Eastern cities. It is reported that he purchased some new machinery for the plant, and that it will soon arrive and be immediately installed.

IT HAS BEEN decided to operate the tramway which has just been constructed between Torreon and Lerdo with electricity. An iron bridge is being erected across the Nazas River, and as soon as this structure is completed the electric plant will be installed. The road runs through the rich Tlahualila farming region.

French Notes.

(From Our Own Correspondent.)

Paris, July 23, 1898.

NEW TELEPHONE LINE BETWEEN BRUSSELS AND PARIS.—With a view to secure eventually telephonic communication between Paris, Holland and Germany, the French and Belgian telegraph authorities are at work continually on a fourth line between Paris and Brussels, which is to have the remarkably large cross section of 40,000 circular mils metallic circuit. This line, with its very low resistance, will be especially well adapted to telephone service. The weight of copper which will go to equip it will reach the respectable figure of 94 tons.

PARIS ACADEMY OF SCIENCES.—Meeting of June 27, 1898: M. L. Bonetti read a paper on an improvement in X-ray tubes. By changing the condition of the rarefied gas in the bulb he has succeeded in getting a reduced resistance, and in this way he was able to utilize a tube which had become too high and was consequently useless. The method consists in keeping a platinum wire which is inclosed in the tube in a state of incandescence for an indefinite period of time. M. Bonetti uses an electric current for this purpose, so that what he has is practically an incandescent lamp with a platinum filament.

ELECTRIC TRACTION ON CANALS.—A powerful French company has recently sought to obtain from the French, Dutch and Belgian governments the right to establish electric traction on the waterways of these three countries. The intention is to construct a network of electric towage systems, stretching from the Rhine to Marseilles, through Eastern France, making use of the chief waterways of Belgium—the Meuse, the canal which connects the Meuse with the Scheldt, the Scheldt, the Terneuzen Canal, etc. Many of the canals of Northern France would also be connected with the Belgian canals and the upper Meuse by this system. It is rumored that this company has made proposals to the Brussels Maritime Company, both for the use of and for the construction of the Willeboeck Canal. The speed of boats hauled by electric traction would be one-third greater than with horses. In addition to this (were this system in use) there would be greater certainty of travel, which would allow coal dealers, for instance, to make contracts ahead of time.

THE ELECTRIC LIGHTING PLANT AT FOUSSERET (HAUTE GARONNE).—Many of the large towns are blocked in their attempts to introduce the electric light on account of the existence of contracts with gas companies, but with the smaller towns it is a different matter, and they have for several years been swinging into line in the march of progress, being unfettered by any agreements which can keep them from utilizing to the fullest extent the many forms in which electric energy can be placed at their disposal. This is the state of affairs at Fousseret, the county town in the department of the Haute Garonne. This place has a population of about 2200, and is about 1 kilometre distant from the Logue, a tributary of the Garonne. The flow of this stream when at low water is about 35 cubic feet; a fall of 10½ feet furnishes power to a 35-hp Schabauer turbine of a new design, called the "American Castraise." The speed is high, 130 r. p. m., and a minimum efficiency of 80 per cent. is guaranteed. This turbine drives two shunt-wound gramme machines, with a capacity of 75 amperes and 120 volts. The brushes are carbon. The energy is distributed on the three-wire system. At present the system has connected twenty-five 20-cp incandescent lamps and four 8-ampere arc lamps for the municipality, and about 150 incandescent lamps in private houses. Fousseret is built on a hill about 250 feet high, so that the electrical illumination produces a fine effect at night. The lessees, MM. Mon-

tannoil et Compagnie, awarded the contract for building the plant to the Schabauer Construction Company, of Castier, whose engineers were warmly congratulated at the opening of the works by the municipality and the inhabitants. The Schabauer Company is not by any means new at this kind of work. They have, in fact, put up a number of plants in the South of France.

CENTENNIAL OF THE CONSERVATORY OF ARTS AND TRADES.—As the result of a decree dated the 12th Germinal, year 7 of the Republic (1797 of ordinary chronology), the Conservatory of Arts and Trades first took shape within the old walls of the Priory of St. Martin of the Fields at Paris. There is now nothing remaining of the abbey except the refectory, which has become a library, and the old chapel, which has been turned into a machine room. On Friday, June 24, the hundredth anniversary of the founding of this institution was celebrated by the opening of the exposition. The inauguration was conducted by the President of the Republic and the Minister of Commerce. Colonel Laussedat is the director of the conservatory. The chief electrical firms represented among the exhibitors were those of Digon, Ducretet, Dejardin, Gaeffe, Richard, etc. The new Dussaud micro-phonograph, built by the Telephone Company, and the silicon electric faggots of M. Le Roy attracted some attention. The firm of Richard showed some portable magnetic voltmeters and some recording voltmeters actuated thermically, which, being without self-induction, can be used on either alternating or direct currents. Also two recording voltmeters (one of 300,000 watts capacity, the other of 300,000) which complete the record which they furnish by giving the exact time of production of the energy. Also an energy meter combined with a recorder, which performs a similar duty. The Schneider Company, of Creusot, has on exhibition a three-phase alternator of 70 kilowatts capacity and 3000 volts, driven by a Thury direct-current motor. M. Ducretet performed some experiments in wireless telegraphy before a large audience, and M. Radigues gave some new experiments with Röntgen rays. The gardens, galleries and halls of the conservatory were brilliantly lighted at night by large numbers of acetylene lamps, furnished by the Metallic Carbide Company, and by arc lamps of all kinds furnished by the Clemeurcon Company.

General News.

NEW INCORPORATION.

ELECTRIC TERMINAL COMPANY, Cleveland; capital, $300,000; to erect buildings for the use of telephone and electric street railway companies. Incorporators: H. A. Everett, C. W. Wason, E. W. Moore,, B. Mahler, W. F. Carr.

THE TELEGRAPH AND TELEPHONE.

ALEXANDRIA, MINN.—The Village Council has granted the Alexandria Telephone Company the right to put in local telephone service.

LINCOLN, NEB.—The Nebraska Telephone Company is busy at work on extensions of its lines and the line between Seward and David City will be completed in a month, ready for public use.

MONROE, N. C.—Application has been made to incorporate the Monroe Telephone Exchange. The incorporators are John M. Blair, W. S. Lee, R. A. Morrow, C. W. Bruner, W. B. Houston and J. D. McRae.

DENVER, COL.—The Colorado Telephone Company has established a new line from Leadville to Granite, a distance of 18 miles. The line runs through Twin Lakes. Granite is south of Leadville on the Arkansas River.

ST. PAUL, MINN.—The Northwestern Bell Telephone Company has filed with the Secretary of State an amendment to the articles of incorporation providing for an increase in the capital stock of the company to $4,000,000.

SALINA, KAN.—The Missouri & Kansas Telephone Company has completed its line from Salina to Junction City. From there it is building a metallic circuit to Kansas City, and will be in connection with that place in about three weeks.

KALAMAZOO, MICH.—The Kalamazoo Mutual Telephone Company has asked the Council for a franchise to allow it to put its telephone wires in conduits under ground. The proposition comes from the company, as it claims such a system will be much cheaper to operate.

BOSTON, MASS.—Official statement of the Southern New England Telephone Company at New Haven shows the condition of the company June 30 as follows: Capital stock paid in, $2,511,000; debts, $573,986; credits, $188,774; real estate, $160,298; personal property, exclusive of patents, $2,680,944.

MONTREAL, QUE.—The directors of the Bell Telephone Company have decided to increase the capital of the company from $3,168,000 to $3,900,000. Each stockholder of record on July 29, 1898, is entitled to take at par shares of the new stock in the proportion of one share for every four shares now held.

JAMESTOWN, N. Y.—The Ripley Telephone Company, Ripley, N. Y., has been incorporated. The capital stock is $12,000. The directors are S. Fred Nixon, Vernon A. Kent, Otis L. Ingalls, Clayton J. Bannister, of Westfield; Fred N. Randall and J. Watson Burrows, of Ripley, and George H. Frost, of Buffalo.

CHICAGO, ILL.—There has been considerable increase in the business of the Chicago Telephone Company, as is indicated by the return to the city comptroller of 3 per cent. of the corporation's gross receipts from city lines during the first half of 1898. The gain for the first six months of the current year, as compared with the corresponding period in 1897, was equal to about 9 per cent.

DECATUR, ALA.—The American Bell Telephone Company now has a gang of about 200 men at work here pushing its line from this city to Birmingham and Montgomery. A large gang of workmen is erecting two towers 120 and 140 feet in height, which will be used to throw the wires across the Tennessee River, this plan being adopted instead of using the Southern Railway bridge, as was at first proposed.

PITTSFIELD, ILL.—At a meeting of the stockholders of the Pike County telephone lines it was decided to build a line to Pearl at once. An extension to Time and Montezuma was discussed and probably will be made at an early date. A plan to build to Versailles to connect with the lines of the Western Illinois Company has been taken under consideration, and will doubtless result in securing connection with Mt. Sterling before the summer is over.

MONONGAHELA, PA.—Rival telephone companies are about to clash in the Monongahela Valley. The Bell Company has had a monopoly in this territory, but the Maryland, Pennsylvania & West Virginia Company is now making strong competition. The latter has established exchanges at Uniontown and Connellsville, and is putting in an exchange at Masontown. The new company has purchased private lines to Farmington and Masontown from Uniontown, and is hustling to secure right of way to Brownsville and on down the Monongahela.

GOSHEN, IND.—The Goshen Telephone Company, with a capital stock of $30,000, has been incorporated. The system is to be a full metallic one, with 200 'phones and a capacity for 400. The incorporation papers include toll-lines in La Grange, Noble, Kosciusko, Elkhart and St. Joseph counties. The cost of the local plant will be about $20,000 when completed, and it is expected to be equipped with everything that is necessary to make it complete. The list of directors are James A. Arthur, George D. Lint, Wilson Roose, Ed. L. Barber and James S. Brailey.

SIOUX CITY, IA.—The Iowa Telephone Company will have connection in two weeks with Mapleton, Castana, Ute, Turin, Smithland and Rodney. Probably in two weeks the Sioux City exchange will be connected with two branches in Nebraska, which are connected with the Omaha system. The Nebraska Company is building in to meet the Iowa Company, and the Iowa Company is putting in two circuits between Sioux City and Dakota City. The Iowa Company is also building a line south from Cherokee along the branch of the Illinois Central to Onawa.

WASHINGTON, D. C.—The signal corps of the army in Porto Rico has constructed about 250 miles of telegraph and telephone lines, and more than half of the island is thus equipped. From Ponce four different lines radiate, and all are working in good order. The central office is in Ponce. One line runs to the east through Guayama to Arroyo to General Brooke's headquarters; a second line runs from Ponce to Coamo to General Wilson's headquarters; a third through Adjuntas and Utuado to the advanced lines of General Stone, and the fourth from Ponce to Yauco. The lines are being extended as the army advances.

WORCESTER, MASS.—The project of establishing a new telephone company in Worcester has been renewed, and the projectors have held several meetings of late and propose to immediately apply for a charter. The plan is to call it the People's Telephone Company, incorporate it under the laws of Massachusetts, with a paid-in capital of $150,000 and furnish telephone service at a much less price than is charged by the Bell Telephone Company. The men interested are I. L. Currier, Henry W. Aiken, C. H. Sanborn, Dr. Herbert L. Wheeler and Aldermen James H. Mellen. They state that they will give the best of local service at from $18 to $35 a year, according to the class and purpose of the instruments. A first-class house telephone they will rent for $25.

BOSTON, MASS.—In a circular to the stockholders of the New England Telephone & Telegraph Company, dated August 6, the board of directors orders that 5707 shares of the capital stock of the company now remaining unsold in the treasury be offered to stockholders for cash, at par, in proportion to their respective holdings. Each stockholder of record at the close of business Saturday, August 20, 1898, will be entitled to take, at $100 per share, shares of the stock to be sold in the proportion of one share for every twenty shares then held. This right to subscribe will expire at 1 o'clock in the afternoon of Saturday, September 24, 1898. Payment for the number of shares so subscribed for, at the rate of $100 for each share, must be made to the treasurer at his office on Wednesday, November 16, 1898.

ELECTRIC LIGHT AND POWER.

CRESCO, IA.—Cresco voted for an electric light plant.

GRAFTON, W. VA.—The election for the purpose of voting bonds for electric light purposes was carried by a large majority in favor of the proposition.

HEALDSBURG, CAL.—The plans and specifications for the city water works and electric lighting plant have been completed by Engineers Barnes and Dodge, and are now being printed to place before bidders.

GALLATIN, TENN.—The Board of Aldermen has decided that the town should put in an electric plant at its own expense. The following committee was appointed to procure estimates for plans suited for the purpose: W. G. Schamberger, R. M. Jones and John Fry.

PHILADELPHIA, PA.—The Pennsylvania Manufacturing, Light & Power Company, which recently purchased the Hestonville Railway Company's power house at Twenty-fifth and Callowhill Streets, is making arrangements for enlarging the station and converting it into one of the largest power plants in the country.

JERSEY CITY, N. J.—The Hudson County Electric Light Company, which has been operated for several years by the General Electric Company, has passed into the hands of a local syndicate represented by Edward F. C. Young, Bernard M. Shanley and Miles Tierney, who are connected with the North Jersey and Consolidated Traction Companies and the North Hudson County Railway Company. The company will be reorganized and new officers chosen.

CHICAGO, ILL.—Arrangements are being made by the Commonwealth Electric Company for an issue of $2,000,000 of 5 per cent. forty-five-year bonds. The total authorized issue will be $2,500,000, and the mortgage covering them will bear date of June 1, 1898. It will run to the Northern Trust Company as Trustee. The Commonwealth Company was organized some time ago to take

all the important electric lighting and power business in the territory west of Ashland Avenue, south of Thirty-ninth Street and north of North Avenue. The consolidation of these companies was, it is stated, the work of interests closely identified with the Chicago Edison Company, and as a result the relations between those corporations will be harmonious.

CHICAGO, ILL.—It is stated that the Chicago Edison Company has completed the absorption of every company now furnishing electric light within the city limits. The names of the companies thus taken in are the Hyde Park Thomson-Houston, Hyde Park Electric Light & Power Company, People's Light & Power Company, People's Electric Light & Motor Power Company, Mutual Electric Light & Power Company, Englewood Electric Light Company, West Chicago Light & Power Company, Western Light & Power Company of Lakeview, Edgewater Electric Light & Power Company, Chicago Sectional Ground Company and the Commonwealth Company. The only company not included in the deal is the Cosmopolitan Company, and while it has a franchise and some wires laid it has not a plant, and is not prepared to engage in business.

The Electric Railway.

COLUMBUS, OHIO.—The Cincinnati, Hamilton, Middletown & Dayton Electric Street Railway Company has filed a certificate of a change of name to the Mill Creek Valley Railway.

SCHENECTADY, N. Y.—The General Electric Company has secured control of the Schenectady Illuminating Company and Schenectady Street Railway Company for a consideration of $750,000.

FAIRMOUNT, MINN.—M. T. Haines of this place is working up a scheme to build an electric railroad from Fairmount to Armstrong, and has already interested several of our local capitalists in the enterprise.

PETERSBURG, VA.—At a meeting of the Common Council an ordinance was passed granting a franchise to the Piedmont Traction Company, of Charlottesville, to build an electric street railroad in the city. The company will begin the construction of the road at once.

FRANKLIN, R. I.—The initiative has been taken by the Milford & Franklin Street Railway Company in securing the right of way for an electric road between here and Milford, Woonsocket, the Uxbridges and Wrentham. There is little doubt that the franchise will be granted.

ELIZABETH, N. J.—One of the largest bids for a trolley franchise was made on August 4 to the Union County Board of Freeholders by ex-Congressman John Kean. The bid was for $250,000, provided the franchise for the Westfield Avenue road to Plainfield was made for seventy-five years. Mr. Kean made the proposition in the name of the Elizabeth Street Railway Company, which he owns.

RICHMOND, VA.—The motormen and conductors of the Main Street line of the Richmond Railway & Electric Company tied up the line for an hour on the morning of August 7. The company proposed a cut in the wages of the motormen and conductors of nearly 50 per cent. and the men refused to go to work. After holding out an hour the company agreed to pay the regular wages for the day. It is thought that the end of the trouble is not yet.

QUINCY, ILL.—The entire electric street railway system was sold on August 5 to a Maine syndicate represented by W. B. McKinley, of Chicago. The same syndicate controls the street car systems and the electric light plants in Joliet, Bay City, Champaign, Springfield, Ohio; Trenton, Mo., and other cities. The consideration paid here was about $220,000. The syndicate will at once spend $100,000 for extensions and rolling stock. Capitalists in the same syndicate expect to close deals for the gas works and Thomson-Houston electric light plant within a few weeks. If all the plans are completed an investment of nearly $1,000,000 in cash is likely.

BROOKLYN, N. Y.—In the County Clerk's office have been filed the formal papers in the merging of the Nassau Electric Railroad Company, the Coney Island, Fort Hamilton and Brooklyn Railroad Company with the Kings County Electric Railroad Company and the Union Railroad Company. The consent was also filed of the State Railroad Commission to the increase of the capital stock of the Nassau Company from $6,000,000 to $15,000,000, which is to be divided into $6,500,000 cumulative 4 per cent. preferred stock and $8,500,000 common stock. The liabilities of the Nassau Company are $5,500,000 in 5 per cent. mortgage bonds, a floating debt of $1,811,200 and $480,000 permanent and annual rental charges.

SYRACUSE, N. Y.—The employees of the Syracuse Rapid Transit Railway Company, including motormen, conductors, trackmen, engineers and firemen, went on a strike on August 5 as a result of a meeting in which the men resented the action of the company in requiring them to make a deposit of $25 as a guarantee of good faith. The demands of the employees were refused by the officers of the company, and a general strike was ordered, the intention being to tie up the street-car lines of the city. Four hundred men went out. The differences were settled on August 7 through the instrumentality of the State Board of Mediation and Arbitration. The Rapid Transit Company rescinded its order that every employee shall deposit $25 with the company, and it agrees to settle all future difficulties with a committee from the men.

Trade and Industrial Notes.

MR. C. F. CROSELMIRE, platinum refiner, Newark, N. J., is in Europe on his way to the platinum mines in the Ural Mountains. He hopes to place some large contracts for the coming season.

THE A. & A. NEWS COMPANY, 26 Pitt Street, Sydney, Australia, is in the market for electrical machinery and supplies, and would be pleased to receive catalogues from manufacturers of same in this country.

THE F. & L. PUSH FLUSH SWITCH is one of the most successful of the Electric Appliance Company's smaller specialties. It is claimed to be the smallest push switch on the market, the size of the face plate being only 1¾x3¼ inches. It requires a very small opening in the wall, operates with a very slight pressure on the keys and has many other valuable features, not the least of which is the fact that it is sold at a low price.

THE OPEN HEARTH STEEL PLANT of the Sargent Company, of Chicago, has been running for the past few months at its fullest capacity on several large contracts, among which may be mentioned the castings for 10-inch gun carriages for the United States Government. The Sargent Company states that it has been very successful in this class of work, readily meeting the physical tests prescribed by the Government, as well as the short delivery, which is demanded in most cases.

DISSOLUTION OF PARTNERSHIP.—The co-partnership heretofore existing between Edgar H. Freeman, Walter H. Tobey and another, engaged in the business of electrical contracting and the sale of electrical supplies at No. 32 North Water Street, Rochester, N. Y., under the firm name and style of "Standard Electric Construction Company," was dissolved by mutual consent on June 23, 1898. The business will be continued under the same firm name and style by Edgar H. Freeman and Burton A. Vandy, who assume all the obligations of the old concern.

STANDARD INTEGRATING WATTMETERS.—The Government of Victoria, Australia, has placed an order with the General Electric Company for six 100-volt Thomson integrating wattmeters of varying capacities. These will be deposited in the electrical bureau of the home office of Victoria, and will be used as the official standards by which all electricity meters used in the colony will be tested. In future no meters measuring electrical energy will be allowed to go into service in Victoria unless they agree with those just ordered and receive the final sanction of the Victoria Government.

AMONG THE EXHIBITS at the coming convention of the American Street Railway Association, Boston, will be the following apparatus of the Walker Company: A section of the Walker underground conduit system, with car in operation; a 15-L railway motor in operation, a 15-L motor open to show construction, a 33-S motor mounted, a 33-S motor open, a set of 33-S armatures in various stages of construction, a set of 33-S motor parts, a Walker standard trolley, Walker standard railway switchboard panels with wattmeter, type "S" controllers in operation, and solenoid partitions open and in operation.

THE PARTRIDGE CARBON COMPANY, of Sandusky, Ohio, manufacturer of carbon self-lubricating generator and motor brushes, will be represented at the Boston convention of the American Street Railway Association by Mr. J. S. Speer, secretary of the company. Mr. Speer will be on the ground with samples of the self-lubricating brush, and will be prepared to explain and show its valuable qualities as well as the qualities of the company's electric light carbons for arc lamps of every description. The excellent quality of the Partridge carbons has succeeded in building up for this company an enviable business, which is increasing with tremendous strides.

THE SAMSON BATTERY IN THE WEST.—The Central Electric Company, of Chicago, which is acting as the Western distributer for the various types of Samson batteries, reports a large and continuously increasing use of this product. The Samson battery has attained an enviable reputation as the proper battery for use in heavy service, quite recently introduced by the new Samson semi-dry battery, which has extra heavy zincs and large carbons contained in a porcelain jar and sealed. Its ampere output is very large, and as it is portable it is adapted for use under conditions where open batteries could not be used. The Central Electric Company is carrying large stocks of all Samson types, and is prepared to make immediate shipment on all orders.

MR. H. M. FISK, Wheaton, Ill., manufactures a telephone switchboard which possesses some desirable features. Each drop is complete in itself, and there are no joints to solder. It is easily operated; a simple pressure of the plug to one side as the plug is inserted places the operator in communication with the calling subscriber, and by pressing the connecting plug to the other side connects the subscriber with the operator's generator. The coils are wound suitable to any system of wiring. The board has been thoroughly tested at Wheaton for the past year, and has therefore passed beyond the experimental stage of its development. It is reported to have been found rapid, efficient and in every way satisfactory. The workmanship is the best, and the board is recommended by Mr. Fisk as being a near approach to perfection.

ANOTHER ADDITION TO THE GENERAL ELECTRIC WORKS.—Work on the machine shop of the General Electric Company at Schenectady was begun last week, when ground was broken for what will be a most important addition to the manufacturing facilities of that company. The contracts were let last week to A. & R. Roberts, of the Pencoyd Iron Works, Philadelphia, for the steel construction and to J. J. Turner, of Amsterdam, N. Y., for the masonry, etc. The cost of the new building is estimated at $175,000. The new machine shop will face on the central avenue, opposite building No. 15. It will be 653 feet long and 166 feet wide, and will be divided into three aisles; the central one having a width of 65 feet, the side aisles being each about 50 feet wide. The total floor space of this building will be not less than 144,250 square feet. It will contain the machinery necessary to handle the very large apparatus which the requirements of modern practice have rendered necessary. The need of such an addition to the manufacturing facilities of the company can be appreciated after a visit to the factory at Schenectady at the present time. The many orders both for large machinery and for large quantities of apparatus are severely taxing the facilities, and such has been the rush of orders that the traveler on the New York Central Railroad, as he passes the town at night, sees at least half of the buildings lighted up and filled with employees busily engaged in pushing forward to completion the orders in hand. The working of night shifts has been carried on since the beginning of the year, and according to the superintendent there are few signs of the practice being abandoned for the present. It is expected that the new machine shop will be completed before the end of this year. The machinery will be driven by the current transmitted from Mechanicville, 17 miles distant. In addition to the new machine shop the company is making several important extensions to other buildings. The new foundry, which was recently begun, is now in position to receive the iron work, the support for the great traveling crane having been erected last week. It is claimed that this building when finished will contain the largest foundry under one roof in the world.

CONCENTRATION OF POWER BY ELECTRIC TRANSMISSION.—One of the most forcible of the advantages of electrical transmission of power is that this method often makes it possible to combine two or more steam plants into one, greatly diminishing the cost of labor and supplies. Such an advantage appeals especially to the mill owner, who may operate shafting in several buildings or departments by separate sources of power. A conspicuous example of this wasteful arrangement is in the works of one of the largest locomotive shops of the country, where part of the plant is operated by water power, part by steam power, and part by compressed air, the latter necessitating an extra engine and compressor. The polyphase system of electric transmission as developed by the Westinghouse Company has made it possible to centralize the power in such shops. When Lieut. L. O. Garrett took charge of the affairs of the Atlas Tack Company, of Taunton, Mass., as manager, he instituted a thorough investigation as to the power required for the various classes of tack making machinery under normal conditions. The mills of this company at Taunton are three in number, located from 800 to 1200 feet apart, and were until recently operated by three separate steam plants, with the accompanying wastefulness incident to small units. It was found that, owing to variations in the amount of power required from day to day for the different classes of work, the duty of the three steam plants could be easily performed by a single steam plant of two-thirds their united capacity. So large a saving in coal and labor as was expected from this arrangement induced Lieutenant Garrett to engage the services of Mr. T. W. Sprague, of Boston, Mass., to investigate jointly with him the various systems of transmission. The parties interested inspected personally a number of the principal polyphase plants among the New England mills, and finally selected the Westinghouse three-phase system, 3600 alternations, as best adapted to the work of the Atlas Tack Company. This system, in connection with the Tesla "Type C" motors, made by the Westinghouse Electric & Manufacturing Company, has, it is stated, attained marked success in every instance in which a plant has adopted it, and the alternate-current motor, though developed later than the direct-current motor, has been favorably received in all such installations. The Atlas Tack Company is to use a 150-kw Westinghouse generator, which will operate nine Telsa induction motors of the above type, ranging from 3 to 50 horse-power, in the various mills. The gas lighting system of the mills will be replaced by about 1000 incandescent lights.

TRADE AND MISCELLANEOUS PUBLICATIONS.

A CATALOGUE OF THE MACHINE TOOLS manufactured by the Springfield Machine Tool Company, the Whitney Manufacturing Company and the Builders' Iron Foundry, for which Messrs. Patterson, Gottfried & Hunter, 146-150 Centre Street, New York, are agents, has been issued by the last-named house.

"HOW TO SELECT A DYNAMO" is the title of Circular No. 1079, issued by the Walker Company, under date of August 3. The principal features of Walker dynamos are described, illustrations being plentifully used to aid to a better understanding of the points that it is desired to bring out most prominently.

ASBESTOS MATERIALS for pipe covering, roofing, etc., are illustrated and described in a little pamphlet issued by the H. F. Watson Company, Erie, Pa., for which concern Mr. James J. Moran, 98 Maiden lane, New York, is agent. The asbestos materials include pipe and boiler coverings, ammonia and brine pipe covering, asbestos cement filling, retort cement, furnace cement, flexible roofing cement, millboard, sheathing, gaskets, rod packing, etc., etc.

THE DECENNIAL number of the Pratt Institute catalogue (1897-98) describes the aim and scope of this worthy Brooklyn institution. The courses of instruction include fine arts, domestic art, domestice science and science and technology. The Pratt Institute began its work in 1887 with twelve students, and in the succeeding ten years gave training to 25,528 students, and granted diplomas and certificates to 948 students. The two-year courses in drawing and machine design and applied electricity are filling a want that has for a long time been felt in the field of technical education. The aim of the institute is to make its work thoroughly practical.

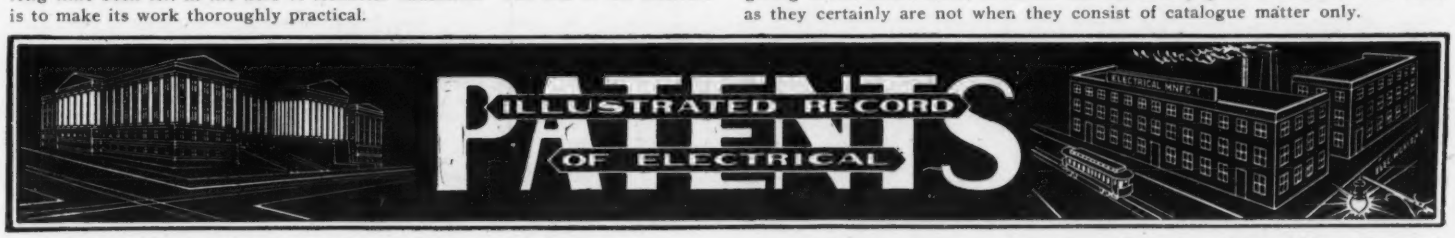
THE D. VAN NOSTRAND COMPANY, New York City, announce the early publication of the first distinctively American pocketbook of rules, formulæ and tables for electrical engineers, to be edited by Mr. Horatio A. Foster, in collaboration with many specialists. The book has been written with the idea of filling a "long-felt want" for an American pocketbook; the data have been selected with very considerable care, and each chapter has been edited and revised by a specialist in that particular subject. The book is not intended for a text book, nor is it meant to be an encyclopedia, but simply a collection of rules, tables and formulæ which will be found handy for reference by the practicing engineer. Its title will be "Electrical Engineers' Pocketbook."

A COMBINED CATALOGUE has been issued by Messrs. Smith & Hemenway, the Utica Drop Forge & Tool Company, the Swedish Razor Company and the Ericsson Telephone Company, all of No. 20 Warren Street, New York City. Among the goods dealt in by the first-named firm are nippers and side-cutting pliers; the Utica Drop Forge & Tool Company also carries a line of pliers of all kinds, and the Ericsson Telephone Company, as is well known, is manufacturer and importer of Ericsson Swedish telephones. In the section of the catalogue devoted to the goods of the last-named concern wall sets, desk sets and interior sets are illustrated and their particular features briefly pointed out. The Ericsson Swedish long-distance transmitter, induction coils, double-pole receiver and the coal-grain microphone are similarly treated.

CHLORIDE ACCUMULATORS IN ELECTRIC RAILWAY SERVICE.—The Electric Storage Battery Company, of Philadelphia, has brought out a bulletin describing and illustrating the installation of chloride accumulators for the Buffalo Street Railway Company. The popularity of this rather new use of storage batteries is shown by the following list of railways now using or constructing chloride accumulators for this purpose: The Union Traction Company, Philadelphia; the Easton (Pa.) Edison Company, the Woonsocket (R. I.) Electric Machine & Power Company, the Central Railway of Baltimore, the Barre & Montpelier (Vt.) Railway Company, the Electric Railway, Light & Power Company, Anaconda, Mont.; the United Traction Company, of Pittsburg, Pa.; the Union Street Railway Company, Framingham, Mass.; the Potomac Electric Light & Power Company, Washington, D. C., and the Consolidated Traction Company, of Pittsburg, Pa. (two stations).

THE BINGHAMTON RAILROAD COMPANY, Binghamton, N. Y., has recently issued its annual Binghamton souvenir for 1898. The book this year surpasses every one of its predecessors in size and artistic excellence, and is a very handsome piece of work. It is profusely illustrated with very clear half-tone views of the city and its features. On the front page are given bird's-eye views of the city as it appeared in 1856 and in 1898. The book is devoted to a description and illustrations of Binghamton and its interests, "and incidentally to boom street railroad traffic." The illustrations show Binghamton to be an interesting and busy town, and to have an air of general prosperity. An excellent description of the Binghamton Railroad Company's system is given. It shows what a powerful influence for the general public good can be exerted by a well-managed railroad company. Mr. G. T. Rogers is the president of the Binghamton Railroad Company. He is one of the most energetic and progressive of street railway men.

APPRECIATION OF THE "IMPERIAL LAMP GAZETTE."—The London "Electrical Engineer" has the following kind words to say of THE ELECTRICAL WORLD and the "Imperial Lamp Gazette": THE ELECTRICAL WORLD is publishing, with the first issue of every month, in its advertising columns, three pages of most interesting and valuable information in connection with incandescent lamps for the Bryan-Marsh Company, of New York City. This latter company has adopted this novel and attractive manner of not only advertising its own excellent product, but in connection therewith gives a current discussion of timely topics on the incandescent lamp, the manufacture of which is in itself an enormous industry. It is called the "Imperial Lamp Gazette," and will certainly be looked forward to by every one interested in the incandescent lamp from any standpoint with the greatest interest. Thus in fact a journal within a journal is obtained, over which the advertiser has complete control. This is a great advantage, and the lamp company is able, by giving useful information, to insure that its three-page advertisements are read, as they certainly are not when they consist of catalogue matter only.



UNITED STATES PATENTS ISSUED AUGUST 9, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

608,614. PLATE FOR SECONDARY GALVANIC BATTERIES AND COMPOSITION FOR PRODUCING SAME; C. Marschner, of Berlin, Germany. App. filed Sept. 30, 1896. A filling composition for the plates of secondary batteries, consisting of an active material, such as lead oxide, and a binding medium composed of a solution of a fossil gum.

608,637. SUPPORTING CLIP FOR OVERHEAD ELECTRIC CONDUCTORS; W. A. Bartley, of Boston, Mass. App. filed May 23, 1898. A clip for overhead electric conductors, comprising two interlocking members provided respectively with fingers to engage opposite sides of the conductor, body portions diagonally opposite said fingers, a sliding clamp adapted to be forced into engagement with the outer surface of said body portions, and means for retaining said clamp after it has been forced into operative position.

608,685. LIGHTNING ARRESTER; J. F. Kelly, of Pittsfield, Mass. App. filed Dec. 16, 1895. A lightning arrester, consisting of a non-conducting containing vessel, in combination with a column of conducting or semi-conducting bodies, in bad contact with one another, within said vessel, and suitable terminals in contact with the ends of the column, respectively.

608,711. ELECTRIC MOTOR; W. H. Powell, of Erie, Pa. App. filed Nov. 4, 1897. A compound wound electric motor, having each of its poles divided into three or more parts, the end parts carrying shunt windings and the middle parts the series windings.

608,714. STORAGE BATTERY; J. D. Rively, of Pittsburg, Pa. App. filed June 9, 1897. A storage battery, consisting of a series of perforated boxes, and of layers of fibre, oxide of lead and plates of conducting material, said plates terminating in positive and negative poles.

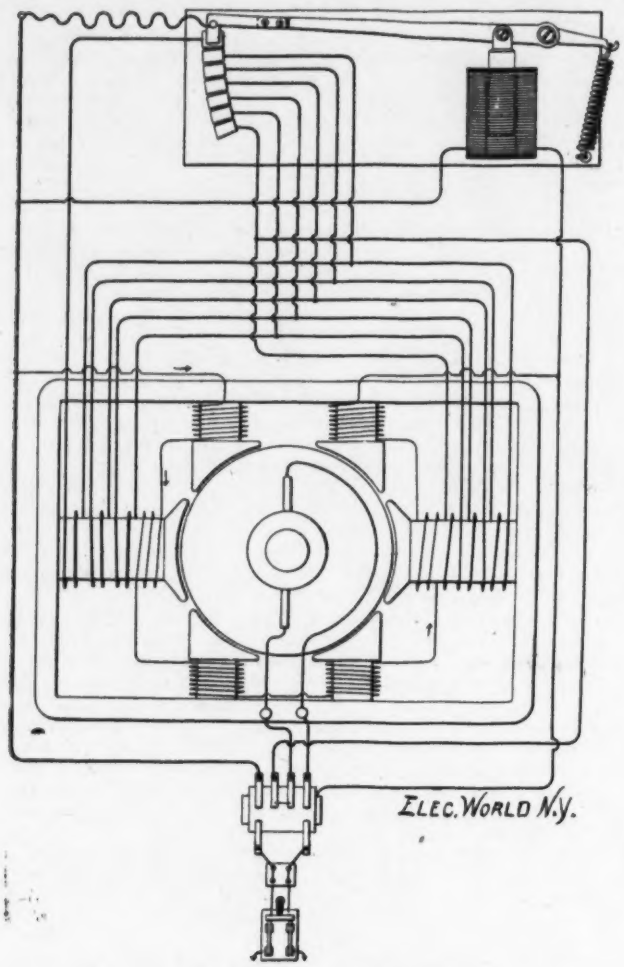
608,721. AUTOMATIC ELECTRIC REGULATOR; R. Skeen, of St. Louis, Mo. App. filed Oct. 23, 1897. An automatic electric regulator, comprising a series of contact points, and actuating means to energize them successively, in combination with a series of lamps or other devices on an electric circuit, of an interposed safety cut-out, consisting of a pivoted bar, one end normally communicating with one or more of said contacts, and the other end adapted to be operated in the extreme position of said actuating means, and insulation interposed between the contact points of said means and pivoted bar.

608,723. ELECTRIC ARC LAMP; T. Spencer, of Philadelphia, Pa. App. filed Sept. 29, 1897. An alternating current arc lamp, provided with a regulating coil and a cut-out actuated when the arc is sprung to cut down the current strength, whereby a starting current of abnormal strength is admitted to the electrodes.

608,736. BOND FOR RAILS; G. A. Weber, of New York, N. Y. App. filed Feb. 7, 1898. The combination with the meeting ends of adjacent rails, fish plates therefor, a bond on both sides of the web of each rail and extending along the same across the joint formed by the said rail ends, and an elastic packing intermediate each bond and adjacent fish plate.

608,755. APPARATUS FOR STORING AND USING SOLAR HEAT; H. Cottle, of Boston, Mass., and J. J. Pratt, of Revere, Mass. App. filed Dec. 11, 1897. An apparatus comprising a body of heat retaining material occupying an excavation or recess in the ground, means for heating the body of material, and means for converting the energy of heat from said material into energy of electricity.

608,842. ELECTRIC METER AND MOTOR; H. P. Davis, of Pittsburg. F. Conrad, of Wilkensburg, Pa. App. filed June 18, 1898. The combination, in an electric meter, of a main actuating means for propelling the meter armature, and an auxiliary actuating means exercising an independent propelling force that varies as the work current varies.



No. 608,711.—Electric Motor.

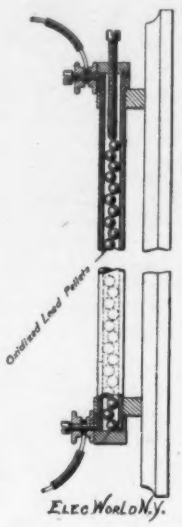
608,846. TELEGRAPH REPEATER; H. P. Donnelly, of Cincinnati, Ohio. App. filed June 23, 1897. A relay having two opposing electromagnets included in different circuits, an armature located between said electromagnets and electrically connected with one of said circuits, and a movable contact device carried by the armature and permanently connected to the ground, said movable contact engaging the armature in one position, so as to connect said armature to the ground directly, while in the other position of the armature said contact is electrically connected with the other circuit and out of connection with the armature circuit.

608,878. SWITCH FOR VARYING ELECTRICAL RESISTANCE; E. F. H. H. Lauckert, of London, Eng. App. filed Nov. 29, 1897. In a switch for varying electrical resistance, the combination with a series of conducting segments connected by successive resistances, of two or more brushes connected to move together, but insulated from each other and electrically connected through a resistance, and designed to be moved over said conducting segments and in contact therewith, one or more of said brushes being of a width to lie over the interval between two segments and out of contact with either.

608,906. INSULATION OF ELECTRIC WIRES; J. A. Poche, of New Orleans, La. App. filed June 22, 1898. An insulation for conductors carrying currents of high potential, consisting of a surrounding insulating sleeve and two inclosing glass cones, retained by a collar at one end and a nut at the other.

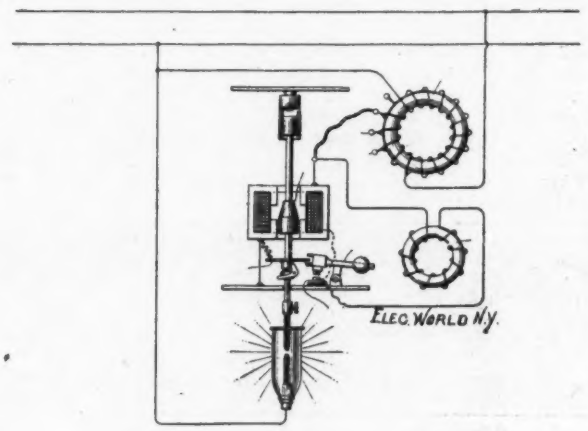
608,911. ELECTRIC CABLE; H. A. Reed, of Newark, N. J. App. filed Oct. 24, 1896. A sheathing or armor for electric cables, consisting of spirally laid wires of copper or other non-magnetic metal.

608,928. APPARATUS FOR HEATING AIR FOR THERAPEUTIC OR OTHER PURPOSES; W. Taylor, of Edinburgh, Scotland. App. filed Dec. 21, 1897. The herein described portable apparatus for producing a heated current of air or gas for therapeutic or other purposes, comprising a casing, a directing tube mounted upon and carried by the said casing, a tube of non-conducting material concentrically within said directing tube, an exposed resistance coil mounted upon the said concentric tube and forming part of an electric circuit, and means within the casing for forcing a continuous current of air or gas through the directing and concentric tubes, whereby air or gas passing through the concentric tube and between the outer walls of said tube, and the inner walls of the directing tube is heated thereby.



No. 608,685.—Lightning Arrester.

608,932. TELEGRAPHY; G. V. Trott, of Chicago, Ill. App. filed Aug. 13, 1897. The combination with a centrally pivoted switch arm, of contact plates, carried thereby upon each side of its pivot, two circuits, contact-forming terminals thereof which are adapted to be closed by the contact plates carried by the switch when the switch occupies one position, whereby two independent circuits are completed, and a second set of contacts adapted when the switch occupies another position to engage the contact plates carried by the switch, whereby the independent circuits are opened and formed into one complete circuit, the conductors of each circuit being thereby included in series.



No. 608 723.—Electric Arc Lamp.

608,952. ELECTRICAL COOKING APPARATUS; J. B. Cary, of Baltimore, Md. App. filed March 14, 1898. In an electrical cooking apparatus, the combination of two boxes, each one having therein heating wires and a corrugated traw situated over the wires, and strap hinges, one member of the same being adjustably attached to a box, whereby the boxes may be separated and held in a separated position.

608,955. STEAM WHISTLE; F. A. Davey, of Detroit, Mich. App. filed June 1, 1897. In a whistle valve, a main steam valve, comprising a freely sliding piston, heads thereon of different area, seats around each head, seats in the casing against which the seats on the pistons respectively bear, the main steam passage to the whistle leading to and control led by the smaller head, and an auxiliary valve controlled passage leading to the larger head, having an exhaust therein.